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- RTX 4060Ti & i5-13600K
- Monster living room gaming PC

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STEP-BY-STEP GUIDE
PG.16

SLAY YOUR RETRO GAMES! **PG.32**

50 WAYS TO SMASH WORK **PG.42**

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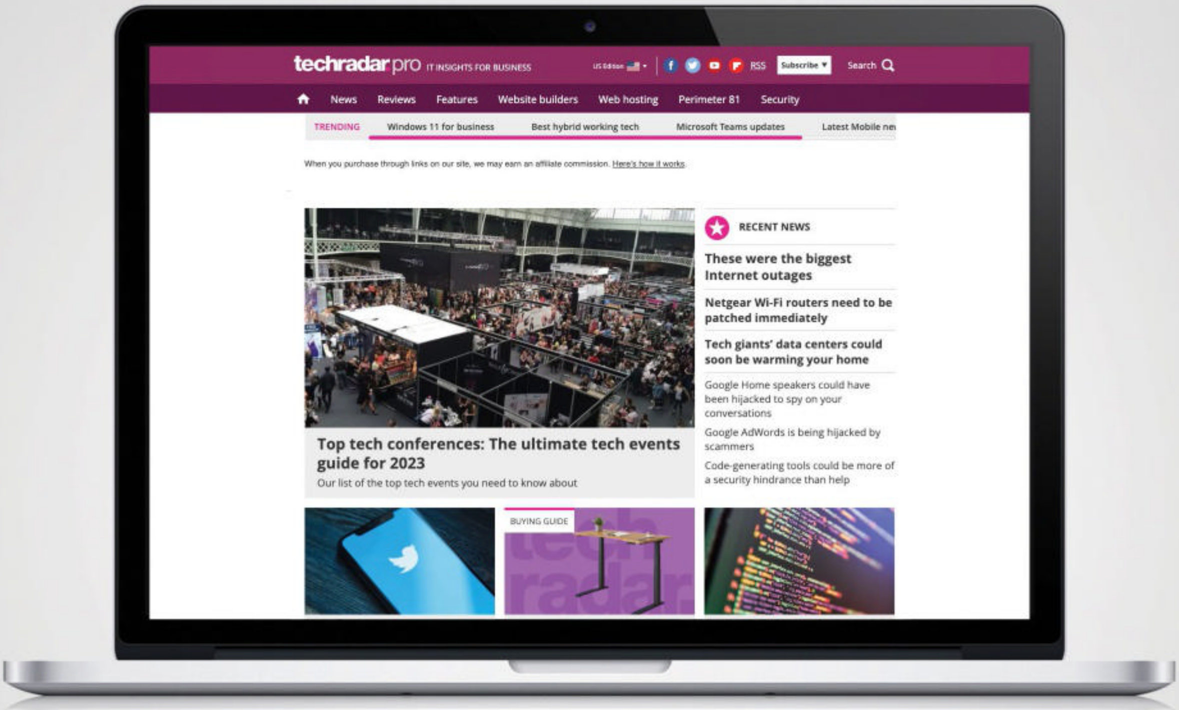

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Editor-in-Chief: Guy Cocker
Staff Writer: Sam Lewis
Contributing Writers: Barry Collins, Tyler Colp, Ian Evenden, Dave James, Jorge Jimenez, Jeremy Laird, Chris Lloyd, David Nield, Nick Peers, Nik Rawlinson, Jacob Ridley, Chris Szewczyk, Jarred Walton
Production Editor: Steve Wright
Editor Emeritus: Andrew Sanchez

ART
Art Editor: Fraser McDermott
Photography: Neil Godwin, Olly Curtis, Phil Barker
Cover Photo Credits: Microsoft, Sega/Gremlin, Sabrant, Future PLC

BUSINESS
US Marketing & Strategic Partnerships: Stacy Gaines, stacy.gaines@futurenet.com
US Chief Revenue Officer: Mike Peralta, mike.peralta@futurenet.com
East Coast Account Director: Brandie Rushing, brandie.rushing@futurenet.com
East Coast Account Director: Michael Plump, michael.plump@futurenet.com
East Coast Account Director: Victoria Sanders, victoria.sanders@futurenet.com
East Coast Account Director: Melissa Planty, melissa.planty@futurenet.com
East Coast Account Director: Elizabeth Fleischman, elizabeth.fleischman@futurenet.com
West Coast Account Director: Austin Park, austin.park@futurenet.com
West Coast Account Director: Jack McAuliffe, jack.mcauliffe@futurenet.com
Director, Client Services: Tracy Lam, tracy.lam@futurenet.com

MANAGEMENT
CEO: Jon Steinberg
MD Tech: Paul Newman
Group Editor-in-Chief: Graham Barlow
Group Art Director: Jo Gulliver

PRODUCTION
Head of Production: Mark Constance
Senior Production Manager: Matthew Eglinton
Production Manager: Vivienne Calvert
Production Assistant: Emily Wood

Future US LLC, 130 West 42nd Street,
7th Floor, New York. NY 10036. USA.
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Guy
Cocker

SMALL BUT MIGHTY

IT TOOK NVIDIA over two and a half years, but we finally have a successor to the RTX 3060Ti in the form of the new RTX 4060Ti. I'm sure many of you will have already seen the online discourse about the merits (or not) of the $399 card, but we have our full verdict on it in our review on page 74. The main concern for most people will be the 8GB VRAM on the card, which seems a little limited in 2023. I won't spoil the review, but if you're gaming at 1080p, you shouldn't have much to worry about—it's the higher 1440p and 4K resolutions where you'd be wise to wait for the 16GB version to arrive this month.

We couldn't wait to get started on a 4060Ti build, however, and our builder, Sam, used the opportunity to drop the small-ish card into a mini-ITX build this month on page 16. This machine is purpose built to either be a perfect small form factor desktop PC, or fit snugly underneath a TV to serve as a gaming and home theater system. With an i5-13600K, 32GB RAM, and Z790 motherboard, I think Sam has nailed the specs when it comes to this system, which is a potent 1080p gaming machine, number-crunching beast, and sleek little mini PC all combined into one.

Elsewhere in this issue, but staying on the topic of living room gaming, we look at how you can play classic computer, console, and arcade games on your PC. Whenever I ask visiting friends if they want to play a game, I'm amazed at how many of them would still rather play the 30-year-old *Street Fighter II* than its 2023 equivalent, *Street Fighter 6*. The same goes for other classics like *Sonic The Hedgehog*, *Mario Kart*, and *Streets of Rage*, and you can have hours of fun revisiting these classics alone or with friends by creating your own emulation library on your PC. Find out how on page 32.

We also have a couple of useful Windows features this issue that will help you be more productive and take care of everyday annoyances. The first, on page 42, compiles the best team and reader tips for 50 Ways to Work Faster across your favorite apps such as Word, Slack and Adobe Lightroom. The second, on page 54, tells you how to take out the trash in Windows, which is to say, streamline your system and address all the little things that slow you or your system down. Hopefully, they help you do more and save time in the Operating System we use every day.

I've mentioned the RTX 4060Ti review, but we also have a new AMD graphics card in our reviews section: the RX 7600. We've been waiting months for these high-value/entry-level cards, then Team Green and Team Red release them concurrently. We've also checked out the new king of the handheld PC gaming devices, the Asus ROG Ally, which has brought the fight to Valve's Steam Deck with upgraded specs and a new design. New monitors, laptops, motherboards, and more round out the reviews section, starting on page 72.

I also want to remind people that our video feature, Story of the Build, is available every month, embedded on page 16. Sam and I talk about the issue's build, how we decided what to create, and how it went, often discussing things that we don't have space to include in the main feature. Check it out and let me know what you think!

Enjoy the issue!

Guy Cocker

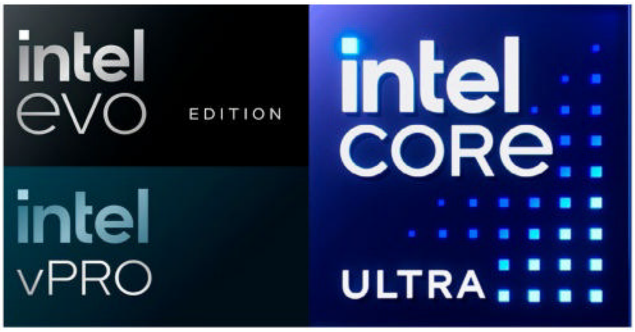
Guy is Maximum PC's Editor-in-Chief. He built his first gaming PC in 1997 to play Tomb Raider *on 3dfx, and has been obsessed with all things PC ever since.*

↘ submit your questions to: editor@maximumpc.com

THE NEWS

Intel Refreshes

Chips, branding, and organization get a new look



Intel has rebranded its entire range of processors. However, the changes are small, and the names are still a tad confusing.

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AS WE EXPECTED, Intel is to refresh its Raptor Lake chips before the switch to Meteor Lake. A round of BIOS updates for existing motherboards for a 'next generation' chip pretty much gave it away—Meteor Lake uses a new socket, so there's no need for them otherwise. The refresh covers both desktop and mobile chips. The mobile parts cover the range, from low-power 'U', to performance 'HX' flavors. We're unlikely to see anything drastic—mostly tweaked clock speeds and core counts. If Intel is true to form, there will be a new halo chip, a binned example pushed to the limit that can grab headlines.

The chips will make decent upgrades for LGA1700 boards if you're not ready to go big, which would mean switching boards and investing in DDR5. The new chips are to be dubbed 14th generation, which smells like marketing—all except the ultra low-power models, which earn the title 1st generation. Why? Because these will use the new branding destined for Meteor Lake. Not confusing at all.

All this fiddling with Raptor Lake has been made necessary by the delay of Meteor Lake. As recently as last summer, Intel claimed things were on track, and Meteor Lake was set for a 2023 launch. Intel might still manage a release of some sort, and it'll try to save face. However, it won't be in any volume. The current word is that Meteor Lake will cover the mobile and mid-range only for the foreseeable future, as Intel struggles to reach high core counts with the new Intel 4. That'll leave a gap to be filled by the high-end refreshed Raptor Lake silicon, with added DDR5 support and a few tweaks to stay competitive.

Intel has also shown off the new logos for its big rebranding exercise. The 'i' is being dropped, and we're getting a new set of names. These are Core (still in 3, 5, 7, and 9 guises), Core Ultra, Core Evo Edition, (for those Evo-badged laptops), vPro, vPro Essentials, vPro Enterprise, and vPro Evo Edition. The Core chips cover the consumer market with the Core Ultra high-end desktops, while the vPro are for business machines. These names will still carry a numerical suffix indicating the chip generation and performance point. The rebrand will debut with Meteor Lake. Essentially, for most consumer desktop chips, all we lose is the 'i', while the best of them will earn an Ultra tag.

Intel claims the rebranding will mark the move to the Intel 4 process, the inclusion of an AI engine, and the switch to a 3D chiplet design, although it'll also be applied to chips without those features. What the rebranding hasn't done is make the names shorter or clearer. Adding the Ultra brand will get confusing, as the Ultra chips will get outpaced by the regular Core brand.

The last piece of refreshing is a restructure of its foundry division, which will become a separate business. This will enable the foundry to compete for jobs not only from Intel, but outside. It will also create the second largest foundry by volume after TSMC. Intel has about 20 per cent of its silicon spun by other outfits. The hope is that the change will save $8 to $10 billion a year. A press release attempts to explain where this saving comes from, but it's a mess of business jargon. Basically, making the foundry business work in the free market will reduce inefficiencies. Intel will have to pay market price for contracts, which will encourage more thoughtful design.

It's all part of its IDM (Integrated Device Manufacturing) 2.0 initiative, the big plan of CEO Pat Gelsinger. It is, as Intel puts it, "The most significant business transformation in [our] 55-year history", the main features being to regain leadership in process technology, expand the use of third-party foundries, and create a world-class foundry business. Mostly, it appears to be panning out. Intel process nodes are shrinking, and its manufacturing capacity is growing. The problems with the Intel 4 process are disappointing, but the targets Gelsinger set always were ambitious. What the company definitely isn't doing is resting on its laurels. **–CL**

> “
> Intel claims the rebranding will mark the move to the Intel 4 process

MICROSOFT DOES LISTEN

PROPOSED CHANGES TO FILE EXPLORER DITCHED

MICROSOFT CAN'T STOP FIDDLING with the interface on Windows 11. In a recent Insider build, it let slip that it was removing features in the folder options for File Explorer. There were nine options for the chop, including showing drive letters, hiding OS files, file icons in thumbnails, and pop-up descriptions. You could, it reassured users, restore the features if you delved into the Registry, but that's hardly practical. Microsoft included the changes in the build to gather feedback, which it got: a resounding no. Given the strength of the push-back, Microsoft decided to ditch all the changes. As it claimed, "We will often try things out and get feedback and adjust based on the feedback we receive". It may be small, but it feels like a victory. File Explorer is a fundamental part of Windows that everybody uses, and removing useful features did not go down well. **–CL**

NEW 12VHPWR DESIGN FOR 4090

New designs for the troublesome power connector

NVIDIA'S MONSTROUS GeForce RTX 4090 introduced us to the equally monstrous 16-pin power connector. Things did not go smoothly. There were reports of cables melting, and even cards getting burnt. It soon became clear that you had to be careful that the plug was seated properly, and the cable wasn't twisted. To make life easier, version 2 of Gigabyte's RTX 4090 Windforce 24G has taken a chunk out of the card's casing to make an inset rearward-facing socket. ASUS also has a prototype board that draws power from an extra slot on the motherboard. MSI uses a simpler solution with strategically colored cables that made it clear when they were fully pushed home. All this fuss could have been avoided if Nvidia's reference design had allowed for a touch more human error. **–CL**

Tech Triumphs and Tragedies

A monthly snapshot of what's good and bad in tech

TRIUMPHS

STOP THE TRACKING
DuckDuckGo has a browser that uses little Google code, and offers a high level of privacy.

LASERS NETWORK
Scientists have made a laser that can shift terrabits per second, enough for a satellite network to replace undersea cables.

44GB RTX 2080 TI
A hardware modder has managed to fit an extra 33GB to a 2080 Ti, thanks to the blank memory chip pads on its PCB.

TRAGEDIES

CHATBOTS FOOLED
ChatGPT and Bard have been ticked into revealing Windows keys via the 'grandmother stories' loophole.

OPEN AI GETS SUED
This is for publishing libelous material after producing untruths about a real person.

AMAZON WATCH
Can't cancel Amazon Prime? The FTC is to look into the practices it uses to ensnare customers.

APPLE'S EXPENSIVE GAMBLE

Could this be the tipping point for AR?

MICROSOFT, Google, and others have tried augmented reality headsets and failed. Now, Apple is having a go, and has pulled no punches. The Apple Vision Pro is an astounding piece of kit, powered by an M2 chip—enough for a decent desktop. Inside are two 90-96Hz micro OLED 4K screens offering unparalleled resolutions with 23 million pixels. It's covered in sensors, including 12 cameras, IR, and LiDAR. The tracking is accurate and responsive, too. The display on the front can show a digital avatar of your face, making interaction with others more natural, albeit spooky.

There are no physical controllers—it's gesture and voice controlled. A rotary knob controls a graduated switch from AR to VR. When in AR, your surroundings are melded with the new visionOS, which places icons, windows, and other OS elements in your environment. You have access to a set of apps covering most of the bases, including 3D videos. Power comes from a battery pack, shifting the weight from your head, which still only gives about two hours of battery life. If you wear glasses, you'll need custom inserts.

If it sounds awesome, it is. Useful is another matter. The AR world of Apple is not going to be cheap, with a price of $3,499—$3,000 more that Meta's Quest 3. It'll find buyers, but the mass market is a way off. Not that Apple could sell these in numbers, as the manufacturing capacity for those micro OLED screens is limited. Apple calls it the "most advanced personal electronics device ever". It has a good case. The Vision Pro will be available early next year as a rich person's toy. However, this is Apple, and currently nothing comes close to doing AR this well. **–CL**

Amazing technology, capabilities, and price. Apple's AR headset is something to behold.

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THE THIRD ARC CHIP

New GPU sits exactly in the middle

WHEN INTEL'S ARC GPUS surfaced, there were expected to be three initial chips. So far, we've seen the ACM-G10, which powers the mid-range Arc 750 and A770 cards, and the ACM-G11, which features in the low-end A380. Now, a third chip has emerged: the ACM-G12. This 6nm chip is to debut in the Arc Pro A60 and Pro A60M cards. Despite the G12 nomenclature, this sits between the G10 and G1. It has 16 Xe cores, 256 vector engines, 16 ray tracing units, 2,048 FP32 cores, and a maximum of 12GB of GDDR6 on a 192-bit bus, making for a maximum bandwidth of 384GB/s. These numbers hit the mid-point between the existing chips, bar ray tracing, which is slightly under halfway. This should give us a good idea of projected performance.

The Arc Pro A60 is a petite single-slot card with x16 PCIe 4.0 configuration—better than the previous Pro's eight-lane design. Why are they 'professional'? Marketing to a large part, although Intel claims that "everything about this graphics card shouts professional", and that it is built to "meet the expectations of our demanding premium workstation manufacturers". It certainly looks to be nicely screwed together, and has been certified compatible with leading professional applications, which is what you pay for with a 'pro' version: guaranteed reliable performance with industry-standard software. It'll support four 'ultra-large' displays via DisplayPort 2.1 HBM10 sockets. The mobile version has a cut-down memory system, with 8GB on a 128-bit bus, but gets a full x16 PCIe connection. The desktop card consumes 130W, the mobile 95W. The A60 card is expected to be available in weeks, and will cost around $175, rumor has it. If this pans out, it'll be tempting for a 12GB card. **–CL**

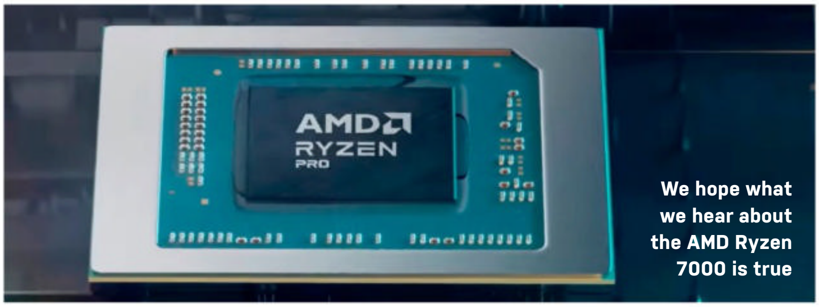
Ryzen 7000 Goes Pro

THE PRO VERSION of processors often lag behind the mainstream consumer chips in their core technology. AMD's new Ryzen 7000 series Pro chips—in the mobile versions, anyway—offer the latest 4nm Zen 4 Phoenix silicon with RDNA 3 graphics to its business customers, and claim to be the world's fastest professional processors for ultra-thin systems. Being a Pro chips means extra security, deployment, and management features, as well as guarantees on software, availability, and validation.

There are six mobile chips: three 'U' low-power, and three 'HS' high-power. The top model is the Ryzen 9 Pro 7940HS. This eight-core chip has a clock of 5.2Ghz, and power consumption of 35-54W. The 'U' have similar hardware specifications as the 'HS', core counts are the same, and clock speeds not far behind. They run at between 15W and 28W. Ryzen's AI acceleration is available on "select models".

AMD has its usual range of bar charts pitting it against Intel offerings, claiming a 17 percent improvement. It included Apple in its charts, claiming a more modest six percent lead. In more specific tests, it pits the Ryzen 9 Pro 7940HS against the Intel Core i9-13900H via selected applications. These tend to be ones that scale across multiple cores. There are also three desktop Ryzens 700 Pro chips, which are basically Pro versions of existing desktop chips: one each of a Ryzen 5, 7, and 9.

Meanwhile, there have been rumors of another V-Cache chip, a six-core Ryzen 5 5600X3D, with the 96MB of L3 cache that make them such rockets. The base clock has been leaked as 3.3GHz, with a boost of 4.4GHz—100MHz slower than the 5800X3D. The eight-core 5800X3D sells for around $289, and a regular 5600 for $199. This is all unsubstantiated, but if true, it'll be a budget gaming terror. **–CL**



We hope what we hear about the AMD Ryzen 7000 is true

ChatGPT Easily Spotted

The AI engine behind ChatGPT is a remarkable thing. It can certainly be used to create writing that, on initial perusal, looks to be the work of a human. Cue dire predictions that much of the internet could be AI creations. We'll see—however, it is important that we spot ChatGPT's work from the real thing, particularly for academic and scientific papers. Early efforts have been patchy, but researchers at the University of Kansas have developed an algorithm they claim is 99 percent accurate. It monitors the habit of academic writers to use certain sentence constructions and ambiguous language. Will people modify ChatGPT to fool it? Nobody wants scientific papers, even if just college essays, to be AI-generated. **–CL**

PCIe 7.0 Gets Mapped-out

PCIe 5.0 isn't universal yet, and PCIe 6.0 chips are at testing, but the PCI Special Interest Group is unstoppable. The organization mulled over the PCIe 7.0 last year, and has confirmed the main features with version 0.3. Speeds will double, reaching 128GT/s on a 16-lane connection. That's 512GB/s without overheads; four times the PCIe 5.0 standard. It'll use the same PAM4 (Phase-amptitude Modulation) introduced with version 6.0. Since 2017's version 4.0, SIG has aimed to double PCIe bandwidth every three years. Version 7.0 is expected to be finalized by 2025, with hardware in 2027. You can never have too much bandwidth, especially as PCIe lanes are at a premium. Version 7.0 will give you full PCIe 5.0 speeds on just four lanes. **–CL**

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Jarred Walton

TECH TALK

Revisiting the slow but capacious hard disk drive

WE DON'T TALK ABOUT hard disk drives (HDDs) much these days. When you're after maximum performance, solid state drives (SSDs) are so much faster But HDDs still have a place, particularly if you have large archives of movies, videos, photos, and other files that don't need a lot of speed.

The cheapest HDDs now start at under $0.015 per GB. The cheapest SSDs start at $0.03 per GB, with more desirable M.2 PCIe 4.0 models that don't use QLC NAND starting at $0.06 per GB—about four times the cost of an HDD. Even though you could buy ten 2TB SSDs for $650, good luck packing ten or more M.2 drives into a single PC.

There are also more expensive HDDs, some potentially costing as much per GB as a cheap SSD. The WD Black tops out at 10TB and costs $240, for example. That might be fine for the capacity, but most HDD users focus on cost per GB over modest improvements in performance.

HDD technology isn't sitting still. Sure, the first 8TB HDDs appeared in 2014, and like so many things, the rate of doubling has slowed down. Now, 8TB drives are ubiquitous, and 20TB models are readily available. There are even plans for 30TB, 40TB, and 50TB drives over the next few years.

The problem with increasing storage capacity is that the areal density—how many bits you could pack into a square inch of disk—plateaued over the past few years. We've been sitting at roughly 1.1 terabits per square inch since mid-2015. Stuffing in more platters is one way to increase capacity, but ten platters is the maximum for a 3.5-inch HDD form factor. The top-capacity drives sit at 2.2TB per platter.

Going beyond 2.2TB requires new techniques. For a long time, hard drives used CMR (Conventional Magnetic Recording), where differing polarities of magnetism were stored on a disk's surface, representing zeroes and ones. These used to be laid down longitudinally, until PMR (Perpendicular Magnetic Recording) took over. That stores the polarity in vertical columns rather than strips, but even PMR has pretty much hit its limit.

Around 2013, Seagate started shipping the first SMR (Shingled Magnetic Recording) drives. These partially overlap adjacent tracks to pack in more data, and SMR can store 25 percent or more data per square inch. The problem with SMR is that writing to a track where the adjacent track contains data means the HDD must read in that existing data and rewrite it. This can reduce performance, especially on nearly full drives. SMR has a reputation for slowing down HDD performance, but that's the price of higher areal density.

The latest approaches to having more data consist of two ideas: HAMR (Heat-Assisted Magnetic Recording) and EAMR (Energy-Assisted Magnetic Recording). In short, heating the surface of a platter with a laser can make the material more receptive to magnetic fields, allowing for more data. The catch is that the hardware needs to carefully manage this, or it can affect surrounding fields.

Seagate recently announced shipment of 32TB HDDs using HAMR Mach-2 technology. It also appears to mark the end of PMR, as capacities above 24TB are "probably" (according to Seagate) combining HAMR with SMR to boost areal density. Even if performance drops, most people buying large-capacity HDDs are more interested in reducing cost per GB, since SSDs already took over the performance sector. Toss in some NAND caching, and perhaps the performance hit of SMR won't be as noticeable.

Jarred Walton has been a PC and gaming enthusiast for over 30 years.

8TB
12TB
TOSHIBA
14TB
IRONWOLF
14TB

A collection of relatively modern hard drives, ranging in speed and capacity. Some models provide up to 20TB of storage for under $300.

THE LIST

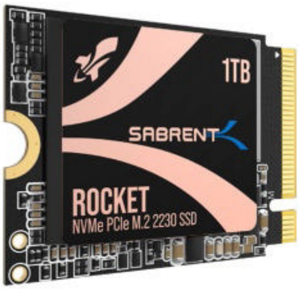
THE BEST NVME SSDS FOR GAMING

AN NVME SSD will breeze through loading screens and make day-to-day PC use a smoother experience. They've been steadily falling in price over the last few months—one *Maximum PC* staffer even bought his first 4TB model this month. There are loads of manufacturers and models, though, which can make it difficult to figure out where to start, or which ones are worth a premium over others. Thankfully, we're here to help sort the wheat from the chaff.

POWER X
M.2 PCIe Gen 4X4 SSD

5 SILICON POWER XS70 2TB

No, we hadn't heard of Silicon Power until recently either, but with the latest Phison controller, high-performance NAND flash memory, and a high-value price point, this really is an SSD worth buying. The XS70 is designed with PS5 compatibility in mind, so the heatsink isn't as bulky as some others you might come across, and if you don't need it, you can just remove it. Only the lack of its own software and hardware encryption lets it down. **$170, www.silicon-power.com**



4 SABRENT ROCKET 2230 1TB

Sabrent's diddy Gen 4x4 drives are a perfect upgrade to your Steam Deck if you want both more capacity and speedier storage. While performance can vary depending on what model Steam Deck you have, in our testing, Sabrent's speeds more than doubled those of the original Deck's Phison SSD, and with a super low power draw of 2W, to boot. In other words, there doesn't seem to be a trade-off in terms of performance and power—that's a win! **$110, www.sabrent.com**

SK hynix
PLATINUM P41 NVMe

3 SK HYNIX PLATINUM P41 1TB

If you need the best, then the P41 is the way to go. When it comes to peak sequential throughput, the Platinum P41 is basically as fast as anything else out there, bar a few rounding errors. That's thanks to SK Hynix's brand new Gen 4 controller, known as Aries. It gets a little toastier than we'd like, so get a good heatsink, but we love the fact that the 1TB and 2TB versions are both as fast as each other. **$90, www.skhynix.com**

2 WD BLACK SN770 1TB

If you want SSD storage on a budget, then the SN770 comes highly recommended. It's more focused on offering value for money than outright performance, which it achieves by being a DRAM-less drive, and thanks to advances in the latest controllers, it can be surprising how little impact this has on performance. It won't beat the best drives on this list, but read and write speeds of 5,150MB/s and 4,900MB/s respectively are more than enough for most. **$60, www.wd.com**

WD_Black™ PC SN770 NVMe™ SSD
www.wdc.com
WD_BLACK™
SN770
Western Digital

WD_BLACK™ SN850X NVMe™ SSD
www.wdc.com
WD_BLACK™
SN850X
Western Digital

1 WD BLACK SN850X 2TB

Extraordinary performance, low operating temperatures, and good value for money—the SN850X has it all. It also ships with WD's Game Mode software, which the company claims improves game loading times courtesy of a so-called "read look-ahead" algorithm, which predictively caches game data. This gives gamers a boost, but we found the drive to be a great overall performer thanks to sister company SanDisk's controller chip. It's available as is, or with a heatsink if needed. **$140, www.wd.com**

© SILICON POWER, SABRENT, SK HYNIX, WD

Jeremy Laird

TRADE CHAT

Apple's unlikely gaming hero. Kinda...

Can Apple save us all from overpriced GPUs?

APPLE? SAVING ANYONE FROM OVERPRICED ANYTHING? The simple answer is no. But the new Game Porting Toolkit, shown at the most recent installation of Apple's World Wide Developer Conference, gives a glimpse of a future where Nvidia and AMD find it harder to hold us all to ransom.

The purpose of the Toolkit is straightforward: it allows unmodified Windows games to run on MacOS and therefore the latest Macs and MacBooks with Apple silicon. In other words, M1 and M2 chips. It's essentially the same as Valve's Proton technology, which lets you run Windows games on the Steam Deck's Linux-based OS, right?

Yes and no. Proton translates Windows code to run on Linux, but the underlying hardware in the Deck remains traditional PC fare. So that's an x86-compatible processor and a GPU designed for the Microsoft DirectX API. What Apple is doing with the Toolkit is a whole different ballgame.

Not only is the code being translated on the fly from x86 to ARM instructions; Apple's M1 GPUs are not DirectX compliant, so it's incredible that modern games run as well as they do via the Toolkit. It's actually possible to get something as demanding as *CyberPunk 2077* running at just about playable frame rates.

Is it as good as running on the latest PC hardware? No, but that's not the point. The Toolkit isn't designed for gaming; it's intended to give developers a baseline from which to optimise games for MacOS—an easy way to identify and tweak performance bottlenecks and problems.

Indeed, the code underpinning the Toolkit isn't actually new. It's based on the CrossOver source code, an existing Wine-based solution for running DX12 Windows games on MacOS. But Apple's backing does rather put a different spin on things.

> What Apple is doing with the Toolkit is a whole different ballgame

Not that it makes sense to buy Apple Macs for gaming. They're expensive and, as remarkable as all this on-the-fly code translation is, much slower at running games coded for Windows than proper PC gaming hardware. Even running games properly ported for MacOS, the hardware has some shortcomings for gaming. But the Toolkit works well enough to raise a pretty compelling prospect. Might PC gaming one day be essentially hardware agnostic?

In other words, might the requirement for an x86 CPU and a very narrowly defined GPU feature set disappear in favour of a more open hardware architecture, and therefore one made up of more hardware suppliers? None of this will be simple. Just because you can run PC games on ARM CPUs, it doesn't mean there will be any ARM-powered systems worth gaming on. You'll still need a high-performance platform to plug that ARM chip into with a powerful discrete GPU—that or a powerful integrated GPU, which is Apple's approach with its "M" chips.

But here's the thing: the easier it is to run code across different hardware architectures, the more worthwhile it is for companies to produce new chips. Historically, it has been a tall order for an outfit like, say, Qualcomm to get in on the PC action. Qualcomm could produce a fabulous desktop ARM CPU with a powerful iGPU, but if there's virtually no software to run on it, it's a non-starter.

On the other hand, if emulation and code translation makes it viable to run existing x86 software on ARM chips, who's to say a company like Qualcomm might not have a crack? Then you might have a new player. An ARM chip company isn't going to blow Nvidia's RTX 4090 monster out of the water, but that isn't necessary. After all, the high end is a small sliver of the gaming market.

Meanwhile, Nvidia's RTX 4060 Ti is ludicrously overpriced at $399, but it's at exactly the kind of performance level that's both more plausible from a new entrant and would also make for a much wider market impact if emulated.

Currently, AMD is happy to largely mirror Nvidia's pricing. Recent data shows AMD gaming graphics cards at about 15 percent market share. But throw in a few more players and the prospect for real competition, and more sensibly priced graphics hardware will be so much better.

Six raw 4K panels for breakfast, laced with extract of x86... Jeremy Laird eats and breathes PC technology.

© APPLE CORP

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> Fix STOP errors
> Faster video encodes
> Is Hasleo crap?

Blue screen of death

I recently booted into Windows, only to encounter the dreaded blue screen of death. On rebooting, the same error popped up again—something about a page fault in a non-paged error. Windows booted to a recovery screen, but I tried one last restart, and this time Windows loaded with no problems. However, Malwarebytes reported that its ransomware protection component had been switched off. Could the two be related, and should I re-enable it? **—Robert M Hagan**

THE DOCTOR RESPONDS: You can find out more about any blue screen of death error with the help of a tool called WhoCrashed. Download and install the free Home edition from www.resplendence.com/whocrashed to access past logs that provide you with detailed analysis of the STOP error in question. After installing, open the app and click Analyze to generate the report, then scroll to read a summary of its findings.

In Robert's case, the description confirmed that "invalid system memory has been referenced". Among the possible culprits was the telling line, "antivirus software can also trigger this error, as can a corrupted NTFS volume". However, although it's tempting to draw a line under this and assume that Malwarebytes was the culprit, it always pays to check out other possible reasons, including drive errors and faulty or overheating RAM/VRAM.

Although Robert only switched on his PC for the first time that morning, his first resort was to check system temperatures using a tool like HWMonitor (www.cpuid.com/softwares/hwmonitor.html), which confirmed no major spikes in temperature that might have indicated cooling problems. Next, he ran a disk check on his system drive (right-click the drive in File Explorer, select Properties > Tools tab. Click Check followed by 'Scan drive'). Again, no problems were found.

The final check was to test the system RAM—we directed Robert to www.memtest.org to download the latest version of Memtest86+, which supports UEFI as well as DDR4/5 RAM. Use the Windows version if you want to create a standalone bootable USB stick, or download the Linux ISO (64 bits) version in zip format if you follow our bulletproof rescue disk tutorial from the June 2023 issue, extracting the ISO file to the root of your Ventoy flash drive. Whichever method you choose, after booting from the disk, choose 'Normal' and the test will start. Allow it around one hour to complete testing 32GB of DDR4/5 RAM.

Robert was pleased to report a clean bill of health from his tests, leaving Malwarebytes as the likely culprit. On re-enabling Malwarebytes' Ransomware protection, he reported no ill-effects, even after a system reboot, indicating that whatever glitch there was had been cleared.

Hardware-encoded video

Having read your video encoding showdown (May 2023 issue), you only briefly touched on the benefits of hardware encoded video. I have many uncompressed HD videos I'd like to encode in MP4 using Handbrake—can I speed up the process using my GPU's hardware encoding capabilities? **—Kevin Anderson**

THE DOCTOR RESPONDS: You can use GPU hardware acceleration with Handbrake—if supported by your graphics chip, you'll find the relevant options (NVEnc for NVIDIA, VCN for AMD, Quick Sync for Intel) on the Video Encoder dropdown on the Video tab. You'll notice fewer configurable settings under 'Encoder Options', and the quality of your video will depend on how old your graphics chip is and what architecture it supports—anything older than Turing (NVIDIA), RDNA 2 (AMD) and HD 600 (Intel) is likely to produce substandard video.

All this disguises one major tradeoff: file size. GPU acceleration is geared towards real-time encoding where file size isn't as important, so while it's a great choice for high-end gaming or transcoding video streams in real time, you will pay a high price in file size. We took a two-hour HD movie and encoded it twice in H264, using the software x264 codec and again with the hardware-accelerated NVEnc codec transferring most of the burden from CPU to GPU. While the NVENC encoding was around 25 percent quicker (14 minutes

↘ submit your questions to: doctor@maximumpc.com to 19 minutes), it also produced a larger output file: 6.9GB versus 3.5GB—almost twice the size.

Hardware-accelerated encoding will be of more benefit to older, slower processors where the difference in encoding times will be more marked, but unless you have plenty of hard drive space, we recommend sticking with your CPU—particularly with large libraries.

Why Hasleo?

I am mystified why you keep touting Hasleo Backup. I'm on my second installation of it—I deleted the first one because the performance was so abysmal—and I've done a drive image on Macrium, a drive image on Acronis, a file and folder backup on Acronis, and Hasleo's file backup is at 15 percent an hour later. Maybe tomorrow Hasleo will get to the drive image I had programmed into it!

Are they paying you to push their (cr)app? Do you just start and let your Hasleo backups run all night? How about covering a free backup utility that is in keeping with today's hardware?

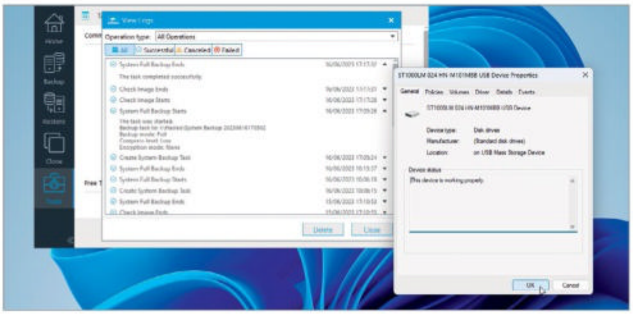
Maybe you think my hardware is old and slow? Ryzen 7 5800X with 32GB RAM and an RTX 3060ti with two external USB 3 backup drives. Not cutting edge, but not slow.

What's the deal? If you have some special setup info you recommend, I'll listen.

—David Winokur

THE DOCTOR RESPONDS: Don't worry David, no money has changed hands. Whatever you may think of our judgment, we haven't lasted this long in the business by forgetting where our loyalties lie: with you, the very readers who pay our salaries each month.

The simple reason we recommend Hasleo Backup Suite is because we rate it. When Macrium Reflect Free was discontinued, our goal in finding its successor was simple: a tool that could match—or surpass—it in three key areas: supported backup destinations and types (full, differential, and—if possible—incremental), built-in image integrity checks to ensure backups could be relied on, and a reliable emergency boot disk to recover any system. Hasleo ticks these boxes and more.



Device type: Disk drives
Manufacturer: (Standard disk drives)
Location: on USB Mass Storage Device
Device status
This device is working properly.

Hasleo Backup Suite contains all you need from free backup software.

© HASLEO

We understand your frustration with the backup tool, but your symptoms aren't necessarily typical. Your system is faster than the Doc's Ryzen 7 5700X setup, but Hasleo runs as smoothly on that as Macrium Reflect Home does. To verify this, the Doc set up a test: a full system backup of his Samsung EVO 970 Plus system drive (256GB capacity, 120GB used) with default settings (low compression and no encryption) to three separate locations: internal hard drive, NAS via an Ethernet connection, and an aging 1TB USB 3.0 drive. Unsurprisingly, the internal hard drive was the fastest, clocking in at around eight minutes (including quick integrity check), and the network took the longest—a respectable 15 minutes. The USB 3.0 drive sat neatly in the middle, taking just 12 minutes for a full backup.

This leaves the Doc speculating that the problem may lie with your USB connection and/or drives. Have you tried them in different ports? How are they formatted? The Doc's tests were performed on NTFS drives, so if yours are formatted exFAT or FAT32, that could be the problem. You might also want to contact the developers on the Hasleo forums (www.easyuefi.com/forums/forumdisplay.php?fid=10) to see if they have any insights. Ultimately, though, it comes down to whether there's any pressing need to persevere with Hasleo when you appear to have alternatives in place.

Can't access eBook server

In your March 2023 tutorial on creating your own self-hosted password manager using Bitwarden, you recommended Nginx Proxy Manager to manage remote connections to your network. Having previously featured Linuxserver's swag reverse proxy in your magazine, I was initially reluctant to switch . However, I took the leap, and am much happier administering the connections to my various self-hosted services via a web-based interface rather than fiddling around with configuration files.

However, after transferring all my docker services—including Jellyfin, Bitwarden, and Nextcloud—I've run into a problem with Calibre (also from Linuxserver). Initially, it worked, but after updating the docker container, I cannot access it outside my local network. It lets me log in, but instead of displaying, the Calibre interface gets stuck on a KasmVNC screen, which tells me UI.rfb is undefined, yet I have no problems connecting through my local network. What gives?

—Charles Myrick

THE DOCTOR RESPONDS: The release notes for the Calibre container reveals that Linuxserver has switched to KasmVNC as its base image—it's this change that has broken things. Thankfully, the Doc has discovered a relatively simple fix. First, you'll need to destroy and recreate the container using the script at https://docs.linuxserver.io/images/docker-calibre—the crucial line is the one that opens port 8181 for remote access.

Log into Nginx Proxy Manager, select the Calibre proxy host, and click the vertical ellipsis button (⋮) followed by Edit. Change the scheme to 'https' and set the port number to 8181, flick the Websockets Support switch to on, and click Save. Once done, access your Calibre instance through its remote domain again (or press F5 if the window is open)—it should instantly work.

Short but not sweet

Hey Doc, I'm being driven to distraction. When I launch my screen capture tool, it tells me it can't register Print Screen because another app is using it. The problem is with OneDrive, but even though I've disabled the screen capture function, it hangs on to the shortcut unless I shut OneDrive down completely. What am I missing? **—Emory Allen**

THE DOCTOR RESPONDS: It's not made clear, but the way to remove OneDrive's control of the Print Screen key is to press Print Screen once while OneDrive is running. A prompt will appear asking if you'd like to use OneDrive to capture screenshots—click No, and the shortcut will be released, allowing your screen capture tool to grab hold of Print Screen when it launches.

THE KICK-ASS MICRO PC

Small case + i5-13600K + RTX 4060 Ti =?

GOOD THINGS come not only in small packages, but also obscure and unique ones. Take the Corsair 2000D case, a new mini-ITX small form factor chassis that quickly grabbed our attention. Shaped similarly to the Xbox Series X, it has the potential to fit into a multitude of setups without sacrificing performance. This chassis follows Corsair's design language from the 4000D and even the behemoth 7000D, but compresses it into a compact and aesthetically pleasing box that will take up less of your valuable desktop or under-TV real estate.

Now, if you know us, you'll understand that we are fairly accustomed to small form factor machines, and we love seeing what we can build within them (although they aren't as easy to build in as chassis like the aforementioned huge Corsair 7000D). We love the idea of cramming a powerful system into a small package, and we are aiming to do just that with the Corsair 2000D.

So then, what are some of the goodies we are compiling inside the 2000D mini-ITX case? Well, things are off to a strong start with the CPU choice of the build. One of our favorite picks from Intel's 13th generation has to be the i5-13600K—it's one heck of a workhorse, and offers great efficiency, gaming power, and value for money. Continuing on with the bang for buck theme, we have chosen the most affordable 40 series Nvidia GeForce card: the RTX 4060 Ti.

The exact card is Zotac's Gaming Edge Twin Edge OC card. Overclocked out of the box and coming in at $400, it's one of the best ways to get yourself into the 40 series range. This card can also run off a 500W PSU, making it ideal for builds with SFX power supplies like this one, where high-wattage SFX PSUs aren't the easiest to get your hands on. Luckily, we did get a more than adequate solution with Corsair's SF750 80 PLUS Platinum SFX PSU. However, if you don't want to upgrade your graphics card, you can opt for a cheaper and less powerful solution.

All of these, plus a very snappy duo of Corsair Vengeance DDR5 and an SK Hynix Platinum P41, will be connected in harmony thanks to MSI's MPG Z790I EDGE Wi-Fi Mini ITX, a very capable mobo to say the least, especially for an ITX board. Yes, this is going to be a fiddly machine, but the end product should certainly be worth the inevitable cable management nightmare that most small form factor builds come with. We are aiming to achieve a compact gaming machine here that can perform at high settings running at 1080p or QHD resolution. It should make for a perfect couch gaming solution.

https://content.jwplatform.com/videos/JMTwit9j-u2lN49He.mp4
Please type this URL into your browser if the link is broken

INGREDIENTS

PART		PRICE
Case	Corsair 2000D RGB AIRFLOW	$199
CPU	Intel Core i5-13600K	$310
Cooler	Intel Laminar RM1	$N/A
Mobo	MSI MPG Z790I EDGE Wi-Fi Mini ITX	$360
GPU	ZOTAC GAMING GeForce RTX 4060 Ti Twin Edge OC 8GB	$400
Memory	32GB (2x 16GB) Corsair Vengeance DDR5-4800MHz	$105
SSD	1TB SK Hynix Platinum P41 PCIe 4.0 NVMe	$90
PSU	750W Corsair SF750 80 PLUS Platinum Fully Modular SFX	$160
OS	Windows 11 Home 64-bit OEM	$32
TOTAL		**$1,656**

PRICES CORRECT AT THE TIME OF PRINTING

A LOOK UNDER THE MICROSCOPE

CPU

INTEL CORE I5-13600K

It has two fewer cores than our previously featured Intel Core i7-13700K, but as it costs nearly $100 less, this Intel Core i5-13600K does not disappoint. It's no secret that this 13600K chip is a favorite of ours—in fact, we'd happily recommend Intel's last generation i5-12600K, as that still stands strong in today's market. It's not going to blow you away, but it should easily last many iterations of hardware changes.

It features 14 cores that are split up into six performance and eight efficient cores via Intel's hybrid architecture. It has a max turbo frequency of 5.1 GHz, 20 threads, and integrated UHD Graphics 770, as it is the 'K' variant. These are healthy stats, and it has never let us down. • *$310* • *www.intel.com*

GPU

ZOTAC GAMING GEFORCE RTX 4060 TI TWIN EDGE OC 8GB

Yes, it's one of the new entry-level cards in the 40 series GeForce RTX lineage, but it's still nothing to turn your nose up at. For 1080p/QHD gaming, this GPU will be a very strong companion to our Intel Core i5-13600K, and more importantly, fit inside our Corsair 2000D with no issues at all. It comes with 8GB of GDDR6 memory, 4,352 cores, a boost clock speed of 2550MHz, NVIDIA DLSS 3 support, and full ray tracing. These are all the features you'll need to amp up your gaming experience on a budget. As it's an OC card, too, it has already been tuned up slightly to help get the most out of the card from the get-go. For a small form factor PC, it's a fantastic choice while still getting the most out of the latest generation advancements. • ***$400*** • ***www.zotac.com***

CPU Cooler

INTEL LAMINAR RM1 STOCK COOLER

Our case features mesh sides and three 120mm fans to pull in air from the front and straight over the internals to keep them cool. Although you can install an AIO, you won't be able to see it, and we felt like the trust Laminar RM1 stock cooler from Intel would be more than enough to reduce the heat levels on our mini-ITX machine. Not only will it help to keep our temperatures down, but also the overall cost of the build.

Intel has vastly improved aesthetics and performance here when compared to the model that came before this. Yet, in this case, unfortunately it's going to be well and truly hidden away. Luckily, it will hide pretty well, as it's a small cooler, allowing for more space internally. Trust us, we need as much space in this build as we can get. • *$N/A* • *www.intel.com*

STEP-BY-STEP P.22

Motherboard

MSI MPG Z790I EDGE WI-FI MINI ITX

Another core component that we unfortunately won't be able to see is our motherboard. Usually, these aren't the most jaw-dropping components, and if most of the PCB is on display, they can make a build look messy and ugly. Yet, this MSI MPG Z790I EDGE Wi-Fi Mini ITX doesn't fall into that category; it's a great-looking silver board, and it's a shame that its beauty will be lost inside this case.

This board not only has the looks, but the credentials to match, especially for an ITX mobo. It has a Z790 chipset, LGA 1700 socket, DDR5 support up to 96GB, EZ Debug LED, Intel Wi-Fi 6E, plenty of USB ports on the I/O panel, and a lightning Gen 5 PCIe slot. Sure, it's not cheap, and you can certainly get a more practical ATX board for less, but that option is out of the equation for this build. We needed something that can keep everything ticking, has plenty of grunt, and has a long life ahead of itself for future upgrades. • *$360* • *www.msi.com*

RAM

32GB (2X 16GB) CORSAIR VENGEANCE DDR5-4800MHZ

Instead of opting for the more premium RGB Vengeance or RGB Dominator sticks, we've gone for the standard Vengeance DIMM sticks to supply our PC with random access memory. The RGB would have been truly wasted here in this chassis, and we prefer just having the three AF120 RGB slim fans to provide the lighting and give the system a clean look.

Anyway, DDR5 prices have been constantly falling, which is great for us, as you can now pick these up for around the $100 mark. It's a fast kit, too, with speeds of up to 4800MHz and a capacity of 32GB. This is a very healthy amount, especially for a small form factor machine. • *$105* • *www.corsair.com*

VENGEANCE
VENGEA

Case

CORSAIR 2000D RGB AIRFLOW

It's small, subtle, has a clean design and can certainly house a machine that packs a punch—what more could you want? Of course, we had to opt for the RGB variant here to add that extra bit of color to our machine. There's a white version available, but we thought that this black version would fit in better with a living room environment. The lighting can all be controlled through Corsair's iCUE software, and there are plenty of customizable options there for you to get the machine just to your liking.

It goes without saying that this is a mini-ITX case, and as soon as we saw it, we wanted to build in it. It features fully meshed sides to allow for great airflow, which is an essential element for small form factor machines. They are a lot more susceptible to overheating, so with help from its three AF120 RGB slim fans, this machine should stay cool. Other features include up to 360mm radiator support, a max GPU length support of 365mm, and a front panel that has two USB 3.2 Gen 1 Type-A ports, a USB 3.2 Gen 2 Type-C port, and a 3.5mm audio in/out connectivity. Not bad for a compact chassis. • ***$199*** • ***www.corsair.com***

SSD

1TB SK HYNIX PLATINUM P41 PCIE 4.0 NVME

This is a very snappy and stable M.2 drive, to say the least. It's competitively priced, and through our testing it has proved time and time again to be a great choice for a primary SSD. Its speeds just back its corner even more, and with read speeds of up to 7,300MB/s and write speeds of up to 6,500MB/s, it's no slouch. It doesn't come with a heatsink, so always take this into consideration and ensure that your motherboard comes with an M.2 heatsink pre-installed, like our MSI MPG Z790I EDGE does. • *$90* • *ssd.skhynix.com*

SK hynix
PLATINUM P41 NVMe

STEP-BY-STEP
P.22

PSU

750W CORSAIR SF750 80 PLUS PLATINUM FULLY MODULAR SFX

To ensure we have more than enough power to run this ship, we've chosen a very densely powered SFX PSU from Corsair, the SF750. With 750W to deliver, it is slightly overkill for this system, as technically we could have gotten away with a 550/600W PSU. However, if we did upgrade up to an RTX 4070, for example, we would have to change the PSU, too, which would end up costing us more in the long run.

750W of power isn't the only trick up its sleeve, though; it has an efficiency rating of 80 plus Platinum, which is fantastic, and it's also fully modular. This helps to keep our build slightly tidier, as we don't need to hide any unnecessary cables inside the case, as you would do if you were using a non-modular PSU.

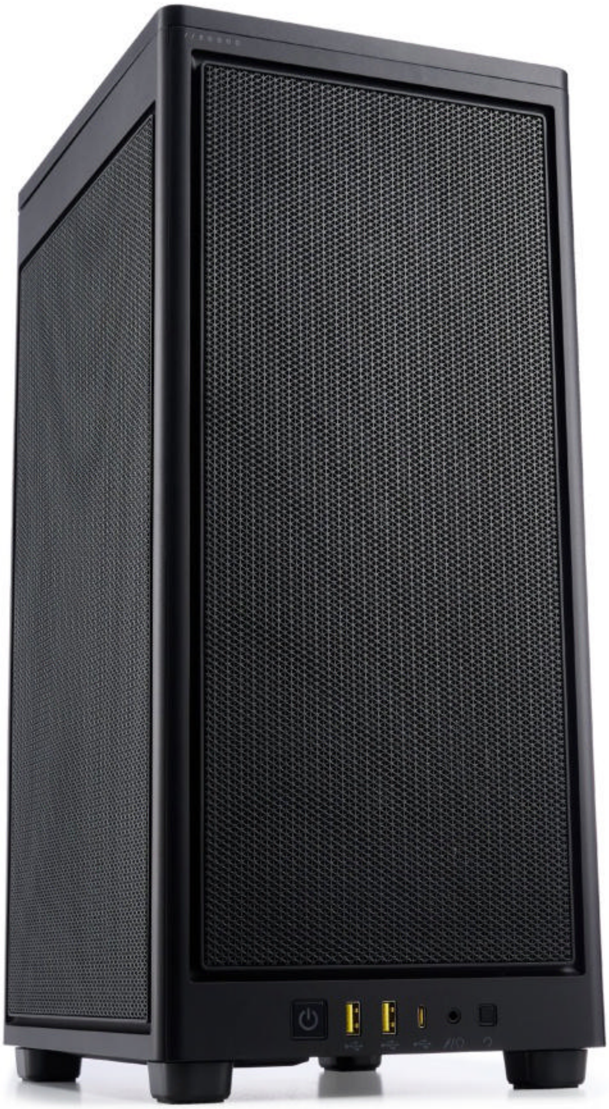
• *$160* • *www.corsair.com*

CORSAIR
SF750
CORSAIR
PERIPHERAL & SATA
24 PIN ATX
6+2 PCIe & 4+4 CPU

TINY & MIGHTY

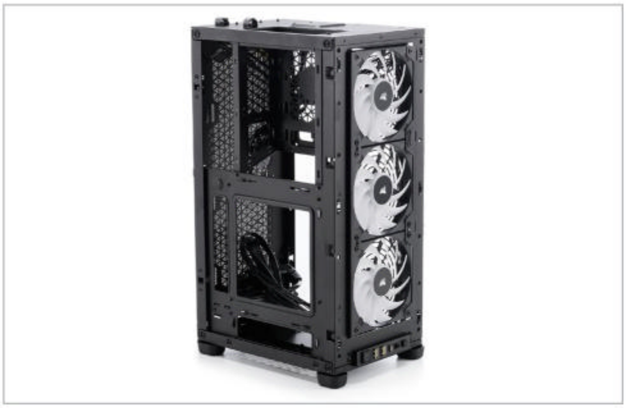
WILL THIS ITX MACHINE PACK AN ATX-SIZED PUNCH?

LENGTH OF TIME: **2-3 HOURS**
LEVEL OF DIFFICULTY: **MEDIUM**



1 BASECAMP

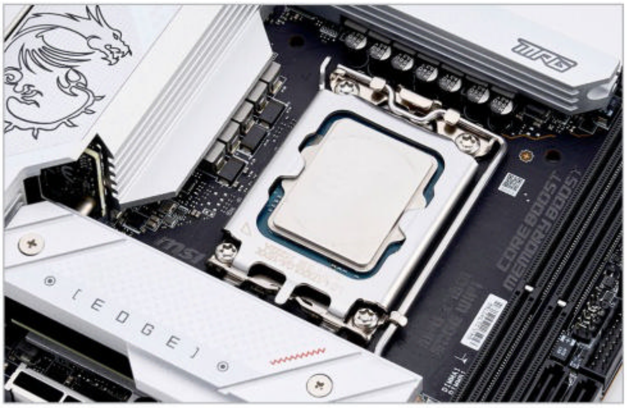
WE LOVE KICKING OFF a build by going to the core chassis and finding out exactly what we're working with. Corsair has made this process very easy for us, as you don't need any tools to get to the key parts of this machine. The top, front, and back panels simply pull off with even pressure, and then what's left are the two remaining side panels. These each have two thumb screws (top and bottom), so loosen these and slide the panels backward to release them. Here, we can now see the case in all its glory, and squirm a little bit as we realize that space might be an issue when piecing this machine together. Luckily, we don't have to mess around with any AIO coolers or additional fans, as the case fans are already in place and connected to the pre-installed RGB fan controller.



2 LEADER OF THE PACK

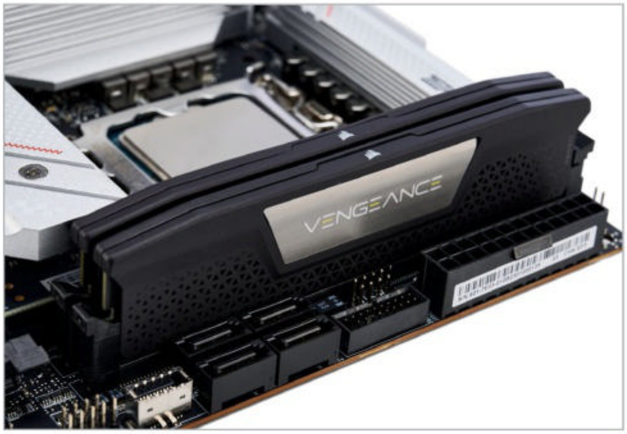
WE NOW NEED to carefully put our case to the side and focus on the motherboard, as we will be installing our CPU first. We also like to keep all the panels safe inside the case's box until we need them at the end of the build. It's recommended to build on top of the motherboard's box when installing components.

First, we need to lift up the retention bar on the side of the socket to open the CPU bracket. If you have a new motherboard, your socket will come with a black plastic cover—don't remove this for now. With the bracket open, we can place our CPU inside. Both the CPU and motherboard will have arrow indicators—make sure these are lined up. Once it's in place, take the retention bar, hook it back into its starting position, and the black protective cover will pop off automatically. Fear not—this is normal.



3 RANDOM ACCESS MEMORY

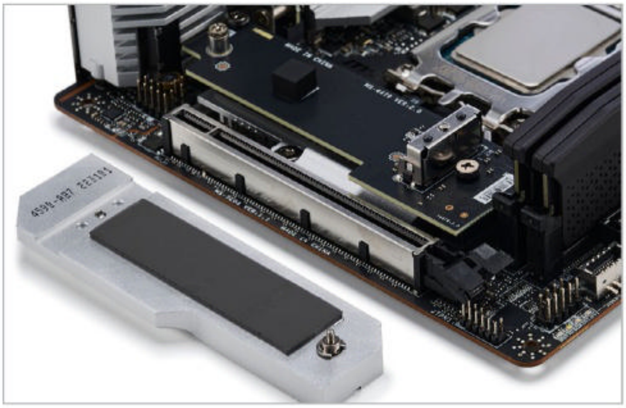
WE'RE GOING TO SOUND like a broken record, but installing the RAM is one of the easiest steps in most builds. Okay, removing the panels on this specific build was easier, but this only requires a few steps. First, we need to open up the DIMM slot clips on the motherboard, found on the outer part of the slots. With these open, you can take one stick at a time, line up the notch on the slot with the notch on the stick, then push it down into position. This will close the clip, a satisfying click letting you know when it's in place. As this motherboard only has two slots, and we only have two sticks, the order doesn't matter. Always check the motherboard's official manual to ensure you get the order of the sticks correctly if you aren't using all the available DIMM slots.



4a KEEPING COOL

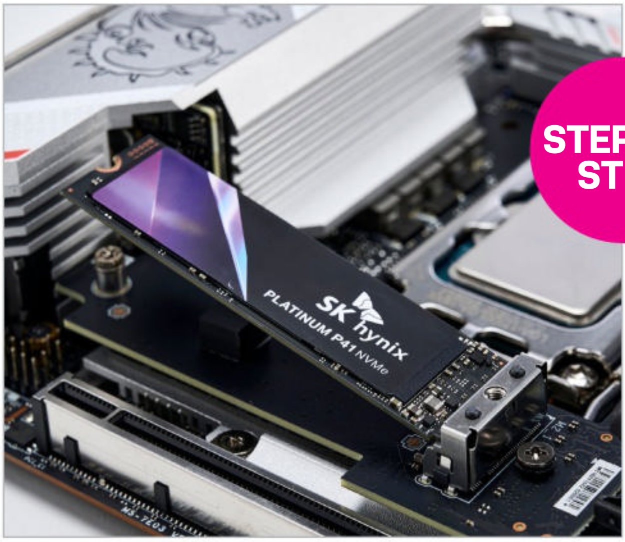
NOW WE NEED to make sure that our super-speedy SK Hynix SSD stays cool. It's a high performance drive that we're going to be pushing to the max, so we need it to be able to operate at its peak. As our drive doesn't come with a heatsink, we need to use the pre-installed one on the motherboard.

This heatsink is seated just below the CPU, and comprises two very small Philips screws that hold it down. Unscrew these, but make sure you don't lose them—they should just stay on the heatsink if you don't undo them too much. However, if you do manage to lose the screws in the heatsink cover, MSI has been kind enought to include a bag of spares in the box. Then we can put the heatsink aside and remove the protective film on the thermal pad underneath it.



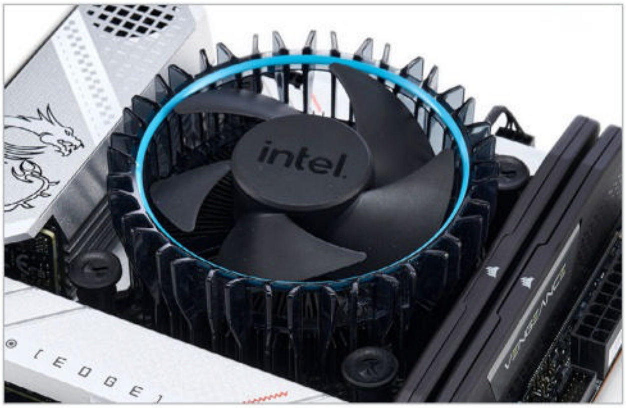
4b INSTALLING THE DRIVE

WITH THE HEATSINK OFF, this reveals the M.2 slot. Take the connector end of the SSD and insert it into the M.2 slot with the branded side of the SSD facing upwards. Be sure to install it at a 30° angle and ensure that it is fully in the slot. After this, we can add the heatsink back. Line the screws up with the screw holes and place it down slowly. You don't want to attempt this too often, as it can loosen the heatsink pad. With the screws in place, tighten them evenly to secure the M.2 SSD onto the mobo.



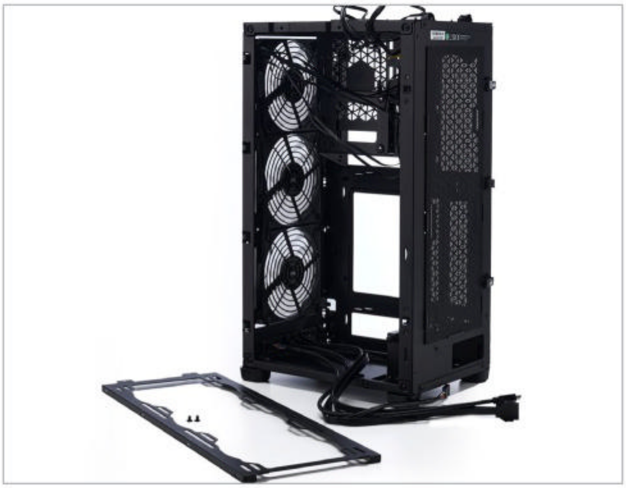
5 CPU BREEZE

KEEPING OUR INTEL Core i5-13600K cool inside the Corsair 2000D is, of course, our stock Intel Laminar RM1, a simple yet effective solution. Compared to an AIO, this is a breeze to install. It doesn't even need a bracket! Before we get going, we need to think about the CPU fan header position, as the cooler only has a short cable, orientate it in a way that is best for cable management, then apply a small, pea-sized amount of thermal paste to the center of the Intel CPU. Next, align the plastic pegs on the cooler with the holes around the socket by wiggling the cooler and letting them rest in position. To secure it down, push down each peg from corner to corner. A satisfying click, just like what we heard on the RAM, will confirm that it is secure. Finally, connect the cable to the CPU fan header on the motherboard.



6 SNEAKY PANEL

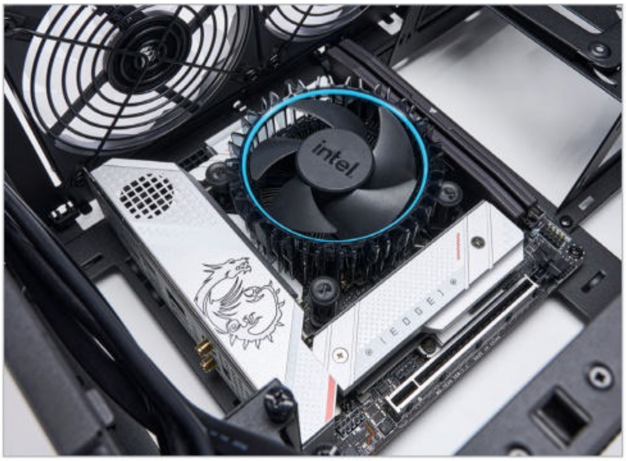
RIGHT AT THE START, it turns out that we didn't fully remove everything we should have on our case! Even we make mistakes—what's a custom PC build without a blunder or two? Anyway, the issue is very minor—we just need to remove the AIO fan/radiator panel, as we aren't going to use it, and it will just get in our way. This only features two screws towards the top. Undo these, and you can lift this panel up and out of your way. Like other panels we aren't using, store them away safely in the PC case box and put these two screws in the small components box that came with our Corsair 2000D, as we won't be re-installing this again.



7 IN YOU GO, MOBO

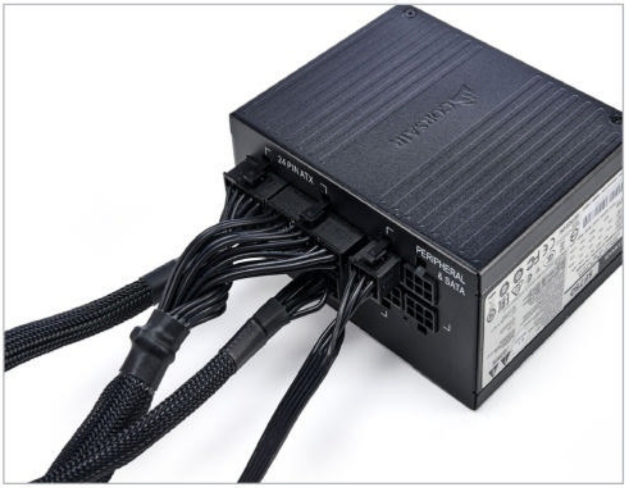
WITH EVERYTHING but our GPU installed onto the motherboard, we can now install it. Always lay the case down flat, as this makes everything easier. The way this fits in is with the I/O panel facing towards the bottom of the case, as there is a slideable cover at the bottom that allows you to insert cables and USB drives, etc.

Anyway, this motherboard only needs four screws to attach to the case. Work diagonally so that even pressure is applied across the motherboard. With this now installed, the build is starting to come together nicely, but a world of cable management issues lurks in the not-so-distant future—we're sorry for the spoiler!



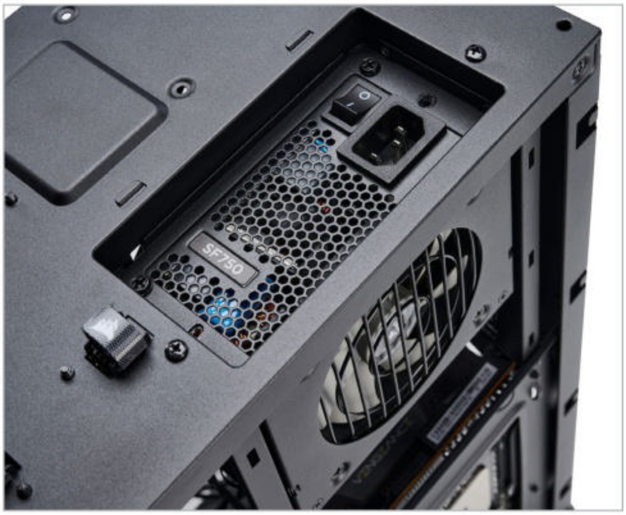
8 SFX PSU CABLES

AS SPACE ISN'T ON OUR SIDE for this build, we need to work smart. This means installing our PSU cables into the Corsair SF750 before installing it. This will allow us to evade any awkward installations later down the road. For us, we just needed the 24-pin motherboard cable, a PCIe cable for the GPU, a single CPU cable, and a SATA cable for both the fan controller and the RGB controller (as these are separate). When installing these into the PSU, make sure there are no loose connections, as this has happened before, and causes a headache and a few painful minutes of unnecessary troubleshooting on bootup.



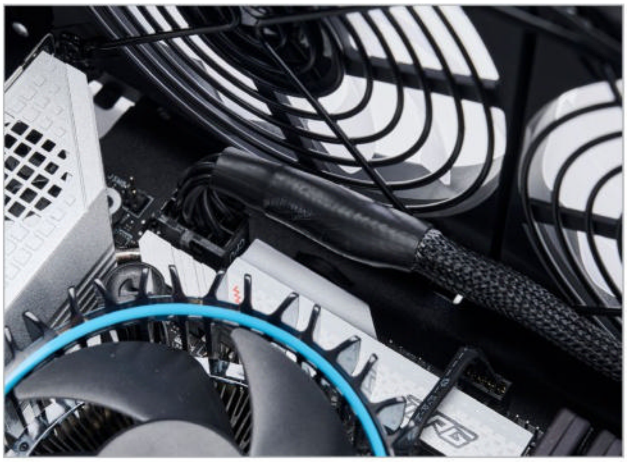
9 SFX PSU INSTALLATION

GROUP ALL of the cables from the PSU in one bunch and feed them through the PSU mount first, then place the PSU into position with the fan of the power supply facing outwards, just as it was in a standard case. The power port and power switch should be accessible on the outside, as pictured. Our power supply can be secured down onto the case using six Philips screws, yet annoyingly, we lost two. This meant we didn't install ones in the center, choosing to add one in every corner instead. Just like when tightening anything in place, work diagonally.



10 PSU CABLES MEET THE MOBO

NOW THAT OUR PSU is installed, it's time to add the rest of the cables. Well, nearly all of them—that pesky PCIe cable can't be installed until the GPU is in place, of course. In this chassis, it isn't the easiest thing to install cables onto the motherboard, so take your time. Although cable management is hard in this form factor, try to find channels alongside the motherboard, as we did for our CPU PSU cable. Luckily, we don't need many PSU cables for this build. Most of our recent builds have required at least two CPU and two PCIe cables, so thankfully we only need one of each here. Our main issue was the lengths of the cables, as the distance between the PSU and motherboard was practically obsolete.



11a PSU CABLES MEET THE MOBO

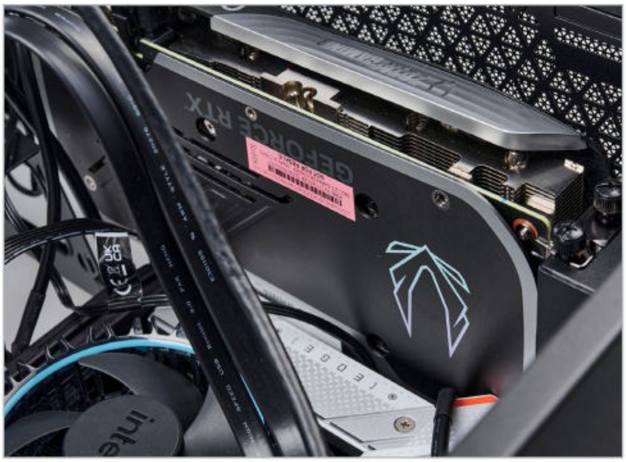
AFTER INSTALLING THE PSU CABLES, we have more cables to add to the mix: the case cables. This caused me a major headache. This was mainly due to the individual power switch pin connectors. At this stage, refer to the motherboard's official manual to make sure you get the order of the pins correct. Some cases come with all of these cables stuck together in one connector, so it's a thumbs down for us on this one. You have to be very patient when adding these, as they tend to disconnect if you get the wire snagged, so be careful when installing the other case cables. As for the audio connector pictured, this was the easiest cable to connect. If you're unsure where to install the cables, your motherboard's manual will be your friend.

11b EVEN MORE WIRES

THIS SIDE OF the motherboard is where most of the mess is situated. We try to erase this image from our memories, but it still haunts us to this day. We're just very grateful that the case is fully mesh, and there are no glass panels, otherwise this would be an even greater issue. Here, you can see the dreaded individual power switch pin connectors and USB cables. These were tight to fit—we tried to stabilize the motherboard from behind when pushing these in to avoid any flex on the board.

12 LAST BUT NOT LEAST

WE ARE NEARING THE END of our journey with the Zotac 4060 Ti. As this GPU will be vertically mounted, and the fact that it is fairly light in comparison to some of its more powerful siblings, a GPU mount isn't necessary. To install, we first need to undo the two screws on the PCIe shroud where the GPU will sit, then make sure the PCIe slot clip is opened. Next, line up the connector of the GPU and the I/O shield, with both the slot on the motherboard and PCIe shroud of the case, and push it down until it clicks in place. With it clicked in, screw in the two screws from earlier to tighten it, then we can attach our single PCIe cable to the front of the GPU. There are no new connectors here, like on the RTX 4090.

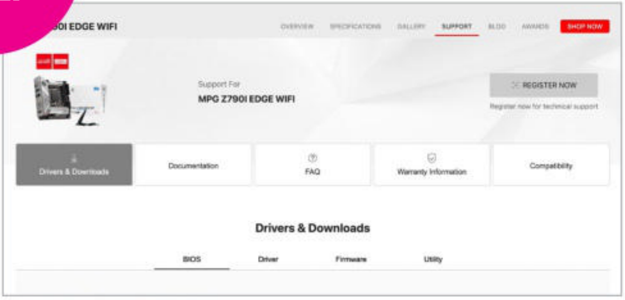


STEP-BY-STEP

13 M-FLASH THE BIOS

ALL OF OUR HARDWARE STAGES are now complete. When booting up, we did have an issue that we'll touch on later, but eventually it booted straight up into the BIOS. We decided to update the BIOS regardless, as this should help with any potential bugs and firmware issues. Our motherboard doesn't have a FLBK/flashback button, so we have to go about this differently.

First, head to the motherboard's official product page using another system. On the support section of the website, download the latest BIOS update available, then extract and copy this file onto the root of a clean USB drive that is formatted to FAT32. Safely eject this USB and insert it into the new build. Boot the system up, and it should load straight into the BIOS. Here, we need to head to the M-Flash section and find our USB drive with the BIOS update. Follow the on-screen prompts, and the system should reboot itself, after which the update will start. Let it do its thing—it may restart several times during this process.



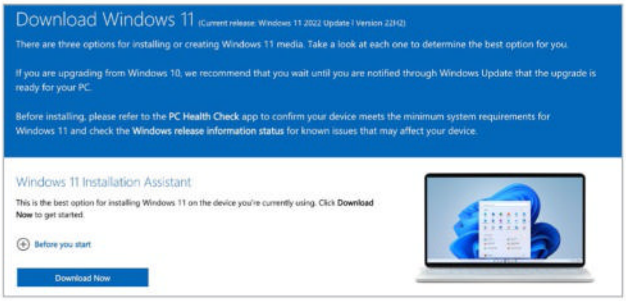
Support For
MPG Z790I EDGE WIFI

Drivers & Downloads

14 THE OPERATING SYSTEM

WITH A FRESH BIOS UPDATE installed and our system booting properly, next up is installing Windows 11. Our favorite method is via the media creation tool. Using another PC, head to the official Windows 11 download page on the Microsoft website. Here, click the download button under the 'Create Windows 11 Installation Media' section. You'll need a clean 8GB+ USB drive that has been formatted to FAT32. Open this file, and follow the on-screen instructions. When it asks you to select where you want to install Windows, select your USB drive and wait for the OS to install.

After the installation is complete, eject the USB drive and insert it into the new build. Turn the system on, and it should boot up into the BIOS. Here, you need to find the boot priority list, which varies depending on the manufacturer. Make sure that your USB drive is at the top, then save and exit. This should reboot straight into the Windows 11 installation wizard. Again, follow the on-screen instructions, and select your SSD when choosing where to install the OS. It's up to you how to customize your system.



Download Windows 11 (Current release: Windows 11 2022 Update | Version 22H2)

There are three options for installing or creating Windows 11 media. Take a look at each one to determine the best option for you.

If you are upgrading from Windows 10, we recommend that you wait until you are notified through Windows Update that the upgrade is ready for your PC.

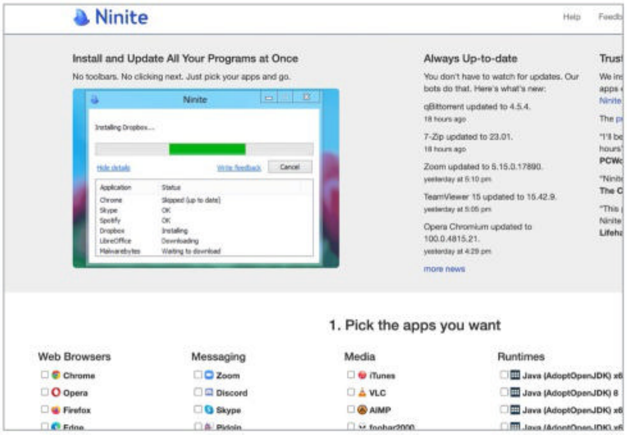
Before installing, please refer to the **PC Health Check** app to confirm your device meets the minimum system requirements for Windows 11 and check the **Windows release information status** for known issues that may affect your device.

Windows 11 Installation Assistant

This is the best option for installing Windows 11 on the device you're currently using. Click **Download Now** to get started.

15 A HANDY TOOL

ALTHOUGH IT'S ENTIRELY UP TO YOU what you do when your system is up and running, this website will inevitably save you a lot of precious time. Ninite is an all-in-one solution to getting your system running with a bunch of helpful applications. Instead of heading to every single individual website and downloading your favorite applications one by one, you can use Ninite to do all the hard work for you. Head to ninite.com—here, you can select a multitude of popular apps, such as Chrome, Discord, Steam, Blender, and much more. Once you've chosen all your required applications, click 'Get your Ninite' at the bottom of the page, and the software will automatically download all of the latest versions of these apps for you. It's that simple!



Install and Update All Your Programs at Once

No toolbars. No clicking next. Just pick your apps and go.

Installing Dropbox...

Application	Status
Chrome	Skipped (up to date)
Skype	OK
Spotify	OK
Dropbox	Installing
LibreOffice	Downloading
Malwarebytes	Waiting to download

Always Up-to-date

You don't have to watch for updates. Our bots do that. Here's what's new:

qBittorrent updated to 4.5.4.
18 hours ago

7-Zip updated to 23.01.
18 hours ago

Zoom updated to 5.15.0.17890.
yesterday at 5:10 pm

TeamViewer 15 updated to 15.42.9.
yesterday at 5:05 pm

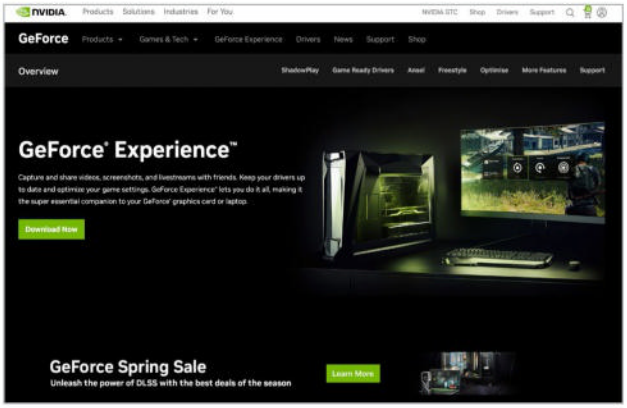
Opera Chromium updated to 100.0.4815.21.
yesterday at 4:29 pm

1. Pick the apps you want

Web Browsers	Messaging	Media	Runtimes
☐ Chrome	☐ Zoom	☐ iTunes	☐ Java (AdoptOpenJDK) x6
☐ Opera	☐ Discord	☐ VLC	☐ Java (AdoptOpenJDK) 8
☐ Firefox	☐ Skype	☐ AIMP	☐ Java (AdoptOpenJDK) x6

16 GPU DRIVERS

DESPITE JUST SINGING its praises, unfortunately Ninite doesn't quite have all the necessary applications, one of which is, of course, the Nvidia GeForce Experience app. This is crucial for any build with an Nvidia Geforce graphics card. It's here where you need to install the latest drivers in order to get the GPU working properly with your PC. You can also apply automatic best settings to your games and a plethora of other neat features to get the most out of your fresh RTX card. Go to the Nvidia official website, find the product page for GeForce Experience, and download it. Once it's downloaded, you'll need to head to the driver tab near the top, click to check for updates, and install any necessary updates. It's always best to restart your system after downloading and installing driver updates.



GeForce® Experience™

Capture and share videos, screenshots, and livestreams with friends. Keep your drivers up to date and optimize your game settings. GeForce Experience® lets you do it all, making it the super essential companion to your GeForce® graphics card or laptop.

GeForce Spring Sale
Unleash the power of DLSS with the best deals of the season

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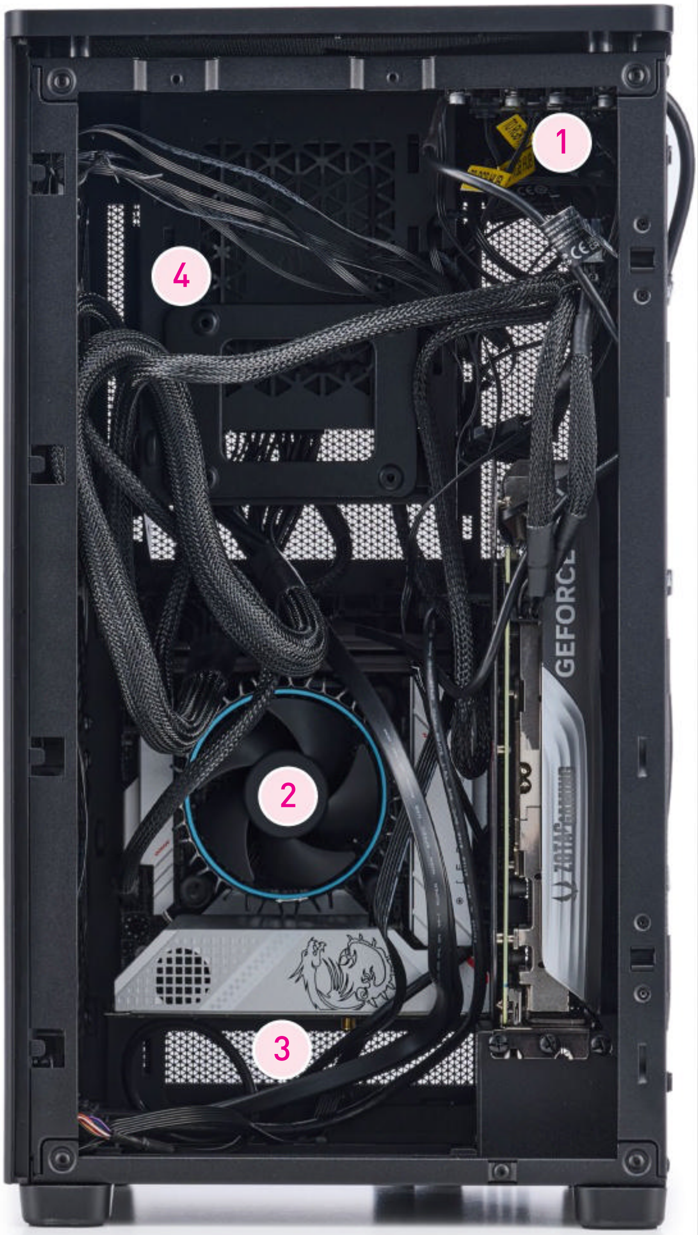


① First off, what a mess! Second, we wish these fan and RGB controllers were located at the bottom to give us space to bundle the PSU cables up here.

② We have to be careful here that we don't catch any cables on the CPU fan.

③ There isn't too much room here, but luckily, you can access the mobo's I/O shield from a slideable panel at the bottom.

④ The PSU fits neatly up here—we just wish there was another compartment to tuck our cables into.

Join the conversation!

Discuss all things PC gaming with fellow readers at our official forums

forums.pcgamer.com

PC GAMER

THE PERFECT LIVING ROOM GAMING SYSTEM?

WE'LL CERTAINLY TOUCH on whether or not this is the perfect living room gaming solution shortly, but first, we need to talk through how this build went down. Before we ever build a small form factor PC, we always get nervous about how awkward and fiddly they can be, and unfortunately that was the reality here. It's just the nature of these mini-ITX machines. As fun and awesome as they are when they're fully functioning, the lead-up to that moment isn't exactly the most stress-free experience, as we can tell you from many such builds. These are still some our favorite systems to build though, so there's clearly a rewarding element to these machines, and that's usually the fact that they can still pack a punch while looking sleek and compact. Anyway, back to the main issues we faced during this build: cables and lack of space.

We knew these would cause problems, but it's still frustrating to go through every time. The building process up to the point where we installed the motherboard was fairly straightforward, and we had no issues until then. With small form factor PCs, you just have to have more patient than usual, and trust that everything will work in the end. It just doesn't help when the weather was extremely hot on the same day that you have to have very steady hands and are trying not to bend or break any motherboard components in a very tight space!

The bottom line is that our cables were too long and caused a complete visual mess inside the chassis, but luckily this was hidden behind the mesh panels. The most important issue we faced was when we first booted the system up and got absolutely nothing whatsoever. Thankfully, this was due to some of the power switch pin connectors coming undone from the motherboard. It was a pain to reseat these cables due to the location of the header, but we managed to do it. Before this, though, we used a screwdriver to create a jump between the power switch pins, which worked, so we knew the issue was the loose connection.

With the crisis averted, the rest of the build went exactly as planned. We set out to create a subtle-looking gaming PC that could easily be used in a traditional PC environment, but also as a console killer when paired with a TV. We think we picked a balanced range of components to achieve this overall, even if the motherboard and PSU, are slightly overkill. However, it never hurts to be futureproofed, or to go with quality components.

If we were to change anything, we would double up our SSD storage capacity to 2TB, just so we can store more games, if anything. We're very happy with the rest of the system. It follows the mission objective strongly, and would make the basis of a fantastic gaming system.

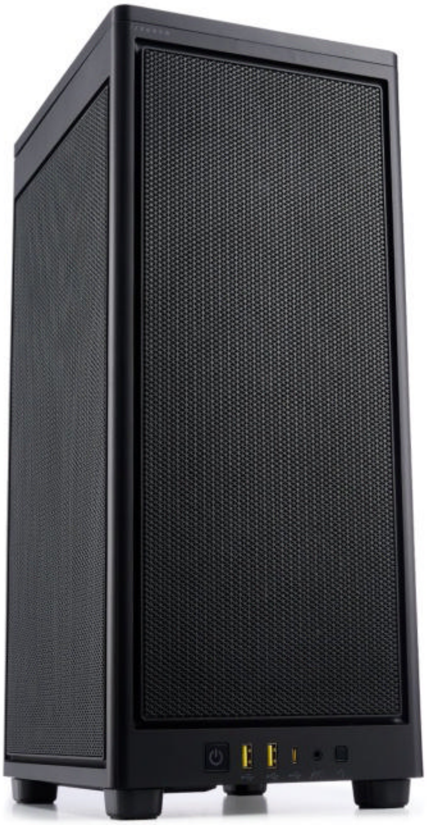
techradar.
72

BENCHMARKS

Don't let its small, console-sized appearance fool you; this machine has impressed us not only aesthetically (ignoring the cable management mess inside, of course), but also with its performance. We already knew that our CPU performance was going to be good—we're huge fans of the Intel Core i5-13600K, as it's fantastic value for money, offering both great gaming and productivity performance straight out of the box. Its benchmarking scores on both the Cinebench tests prove not only that it's a very strong chip, but also that the last generation Intel Core i5-12600K is still well worth picking up, too.

We benched our system against a very similar PC featuring the 12600K that our editor Guy built in August of last year. This used NZXT's H1 case—the V2 model, to be precise, which is also a vertical small form factor chassis. Visually, we prefer the NZXT case to our Corsair offering, but the Corsair 2000D was easier to build in, it puts on an impressive light show, and has better airflow, so it's a close call. Anyway, Guy's build also featured the same RAM, a Samsung 980 Pro SSD, and an ASUS GeForce RTX 3070 Ti GAMING OC 8GB. The street price of that GPU for a brand new unit is around the $500 mark, making our RTX 4060Ti even more tempting, seeing as it's $100 cheaper than the older model. Performance-wise too, it beat the latter system on almost every single test we performed. Of course, this was expected due to it being a generation newer, but we were still happy with our results.

We tested both systems at QHD resolution on ultra settings to get a good feel of how these machines would handle top-end 1440p gaming. In short, they can play our benchmark games at above 60fps on ultra settings, which if you're coming from a console, is more than adequate. Our system specifically can play all titles (*Cyberpunk 2077*, *Metro Exodus*, and *Total War: Three Kingdoms*) above 70fps at this level. In reality, we'd recommend turning the resolution down to 1080p. This way, you'll be able to achieve higher frame rates, and in turn experience smoother gaming. At the time of writing a higher VRAM variant of the RTX 4060 Ti will be released soon, but this 8GB model is strong for 1080p gaming, and if you're more of a casual gamer, this system will make for a great console replacement.



BENCHMARKS

	ZERO-POINT	
Cinebench R23 Single-Core (Index)	1,770	1,879 (6%)
Cinebench R23 Multi-Core (Index)	16,830	17,957 (7%)
CrystalDisk QD32 Sequential Read (MB/s)	6,705	6,808 (2%)
CrystalDisk QD32 Sequential Write (MB/s)	4,925	5,920 (20%)
3DMark Fire Strike Extreme (Index)	16,943	15,210 (-10%)
Cyberpunk 2077 (fps)	61	73 (20%)
Cyberpunk 2077 RTX (fps)	25	26 (4%)
Metro Exodus (fps)	74	77 (4%)
Metro Exodus RTX (fps)	53	56 (6%)
Total War: Three Kingdoms (fps)	74	76 (3%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point consists of the Ultimate Couch Gaming Machine from our August 2022 issue, featuring an Intel Core i5-12600K, ASUS GeForce RTX 3070 Ti TUF GAMING OC 8GB, ASUS ROG Strix Z690-I Gaming Wi-Fi mini-ITX motherboard, 32GB (2x16) of Corsair Vengeance DDR5-4800, 1TB Samsung 980 Pro PCIe 4.0 M.2 SSD and 2TB Corsair Force Series PCIe 4.0 M.2 SSD. All games tested at 1440P 'Ultra' graphics presets with DLSS and V-sync turned off and XMP for RAM speed turned on. No manual CPU overclocking.

GETTING THE MOST OUT OF YOUR MINI PC

A FEW QUICK WINDOWS 11 SETTINGS TO SPEED UP YOUR SMALL-FORM

BEFORE WE START, it's safe to say that mid-tower PCs haven't gone out of fashion by any means. Yet, with advancements in technology occurring all the time, it's inevitable that we're going to get more power from components while they get smaller and smaller. For instance, the fact that laptops can feature RTX 4090s inside simply melts our brains. With this trajectory, small-form-factor PCs are rising in popularity more than ever, and aren't seen as just a gimmick anymore. You can truly achieve full desktop performance in a much smaller package than you could even a few years ago.

We have a soft spot for these mini PCs, and want to ensure that you're getting the most out of yours.

You're going to want the best settings for your PC regardless of whether it will be seated under your gaming TV, so you can do some couch gaming, whether it will hide under your desk as the basis of a very minimal productivity PC setup, or be showcased proudly on display as an all-out gaming desktop machine. Alternatively, if your system is starting to feel a little sluggish, these tips can certainly help you out with that, too.

The home of technology

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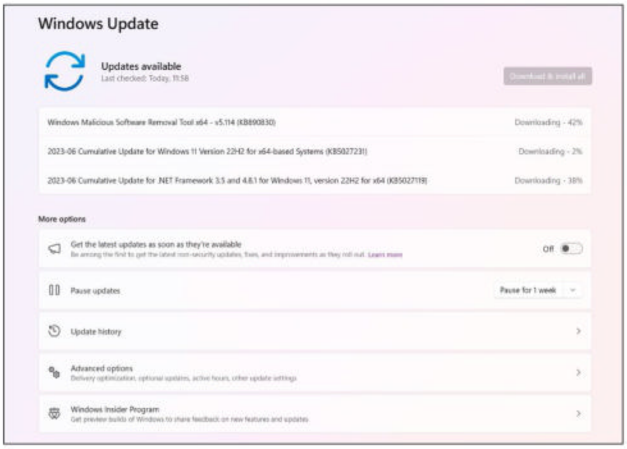


Windows Update

Updates available
Last checked: Today, 11:58

Download & install all

Windows Malicious Software Removal Tool x64 - v5.114 (KB890830) — Downloading - 42%
2023-06 Cumulative Update for Windows 11 Version 22H2 for x64-based Systems (KB5027231) — Downloading - 2%
2023-06 Cumulative Update for .NET Framework 3.5 and 4.8.1 for Windows 11, version 22H2 for x64 (KB5027119) — Downloading - 38%

More options

Get the latest updates as soon as they're available — Off
Be among the first to get the latest non-security updates, fixes, and improvements as they roll out. Learn more

Pause updates — Pause for 1 week

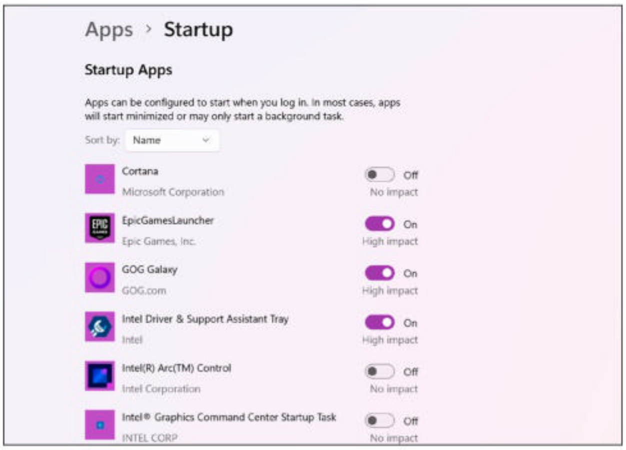
Update history

Advanced options
Delivery optimization, optional updates, active hours, other update settings

Windows Insider Program
Get preview builds of Windows to share feedback on new features and updates

1. Update your OS

This may sound crazy, but there's no such thing as a flawless OS. There will always be a bug or glitch in the system that requires an update to fix. There will always be new pieces of software that come out, aren't fully optimized, and cause new issues. Not only this, but security is a vital part of your operating system, and this has to be kept up-to-date in order to protect you from potential hackers. So in short, to keep your PC safe and running as smoothly as possible so that you get to experience all of the latest features, download and install the latest updates. Head into the settings and then go to 'Windows Update' to check if you have any. On top of this, head into the advanced options section of this page to find any additional updates you may need.



Apps › Startup

Startup Apps

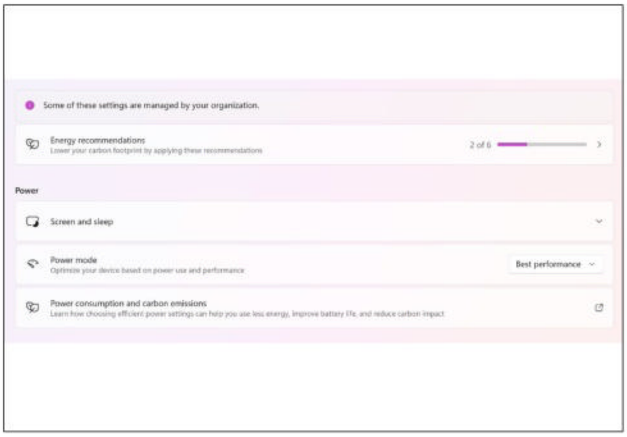
Apps can be configured to start when you log in. In most cases, apps will start minimized or may only start a background task.

Sort by: Name

Cortana — Microsoft Corporation — Off — No impact
EpicGamesLauncher — Epic Games, Inc. — On — High impact
GOG Galaxy — GOG.com — On — High impact
Intel Driver & Support Assistant Tray — Intel — On — High impact
Intel(R) Arc(TM) Control — Intel Corporation — Off — No impact
Intel® Graphics Command Center Startup Task — INTEL CORP — Off — No impact

2. Remove unnecessary processes

By default, a lot of your own and pre-installed apps will want to open up as soon as you boot your PC. Although this can be very helpful and save you some time, the majority of them aren't necessary, and can slow up your PC as it starts to wake up. To avoid this, and to save yourself some processing power, head into the Windows settings, then make your way to the Apps section. At the bottom of this page, you should see the Startup option. Click here, and you'll be able to see the full list of applications that have the ability to start up on boot up. All of these apps will have a toggle switch next to them, and it'll indicate whether these are high-impact or low-impact. Sift through the list and turn off any apps you don't want to open by default in an effort to speed up your boot time.



Some of these settings are managed by your organization.

Energy recommendations — 2 of 6
Lower your carbon footprint by applying these recommendations

Power

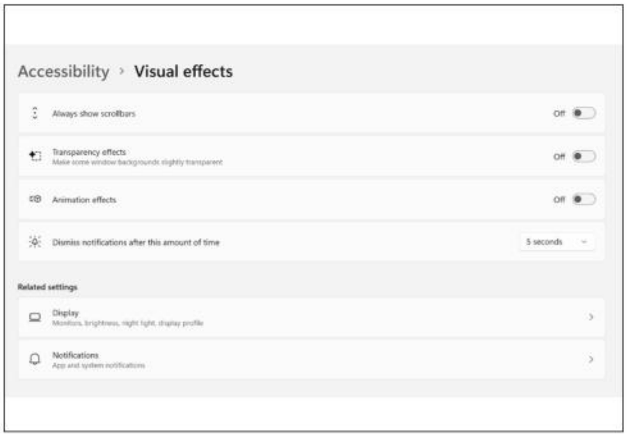
Screen and sleep

Power mode — Best performance
Optimize your device based on power use and performance

Power consumption and carbon emissions
Learn how choosing efficient power settings can help you use less energy, improve battery life, and reduce carbon impact

3. Change your power mode

Another feature that isn't set to the best option by default is the power mode of your PC. This is how you can tune your PC to optimize it based on your power use and performance needs. You can find this option in the main Windows 11 settings, go to System, and then Power. Here, you can also find settings for screen and sleep, so if you get annoyed when your screen turns off too quickly, you can change that here, too. What we're looking for, though, is the Power Mode option. In the dropdown menu, you can choose between best power efficiency, balanced, or best performance (the latter being the one we always pick). Sure, it'll use the most energy, but our Platinum 80+ PSU should help with this too, right?



Accessibility › Visual effects

Always show scrollbars — Off
Transparency effects — Off
Make some window backgrounds slightly transparent
Animation effects — Off
Dismiss notifications after this amount of time — 5 seconds

Related settings

Display
Monitors, brightness, night light, display profile

Notifications
App and system notifications

4. Say no to animations

If outright power is all you're after, and fancy graphics/animations are getting in your way, then fear not: we can eradicate these. That's right—goodbye opening animations, we want our applications to open at the speed of sound, because the speed of light is a bit too much to ask for, isn't it? For this, like all of the other steps, head into the Windows 11 settings first. We then need to go into the accessibility settings on the left-hand side, and then find Visual Effects. There are going to be two options to toggle off here: transparency effects and animation effects. You should notice an instant difference now when opening and closing applications. ⏻

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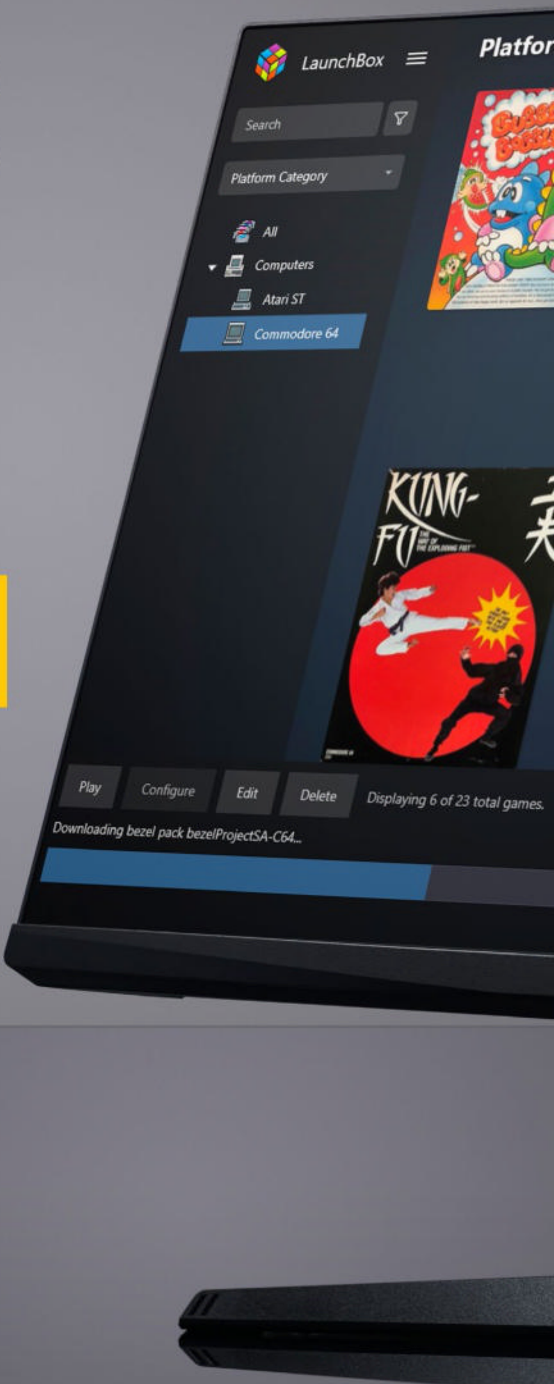
PLAY CLASSIC RETRO GAMES ON YOUR PC

Discover how to emulate old computers, consoles and even arcade machines with *Nick Peers*.



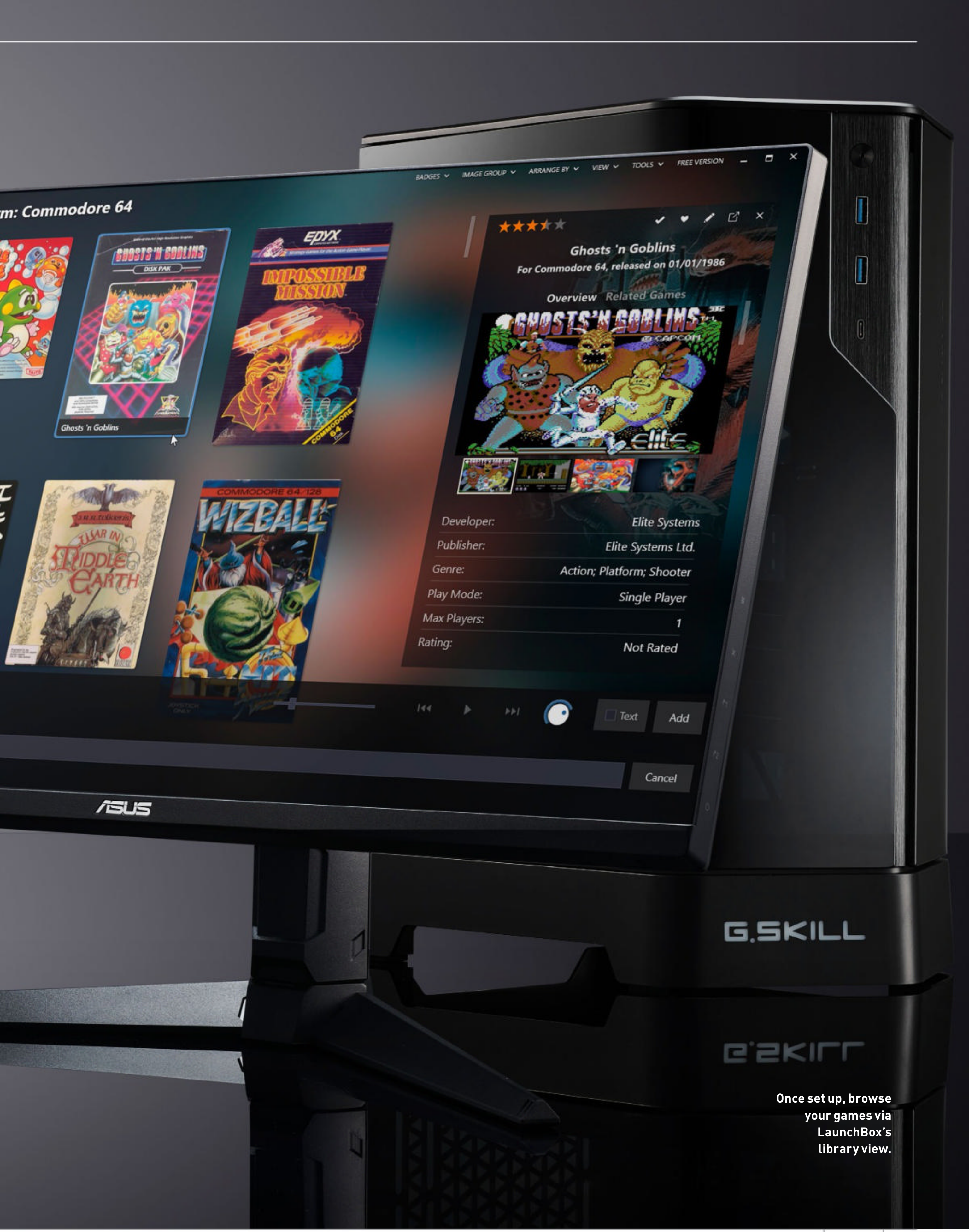
Displaying 6 of 23 total games.

Downloading bezel pack bezelProjectSA-C64...

© LAUNCHBOX

WHEN IT COMES TO NOSTALGIA, you can't beat a bit of retro gaming. Why dig out your old computers and consoles when—armed with the right tools, tips, and know-how—you can recreate your old favorites using your own PC? Emulation—the art of recreating one type of computer in another—is nothing new, as anyone who has attempted to play old 8-bit games on 16-bit hardware will attest. But as PCs grow ever more powerful, their ability to emulate older machines has only got easier over time.

These days, you can emulate just about any gaming machine from yesteryear on your PC, including arcade games. The more powerful your PC, the more options you have, but you don't need anywhere near the latest hardware to relive games released in the 80s and 90s. In this feature, we'll reveal everything you need to know about creating your own retro-gaming environment, from standalone emulators to slick frontends that make running a variety of games across a multitude of platforms as easy as it can be. We'll even help you spec your own dedicated retro-gaming PC and show you how to run retro games on any PC to hand, armed only with a USB thumb drive. Enough chatter—the


m: Commodore 64
BADGES
IMAGE GROUP
ARRANGE BY
VIEW
TOOLS
FREE VERSION
Ghosts 'n Goblins
Overview
Related Games
Text
Add
Cancel
ASUS
G.SKILL

Ghosts 'n Goblins
For Commodore 64, released on 01/01/1986

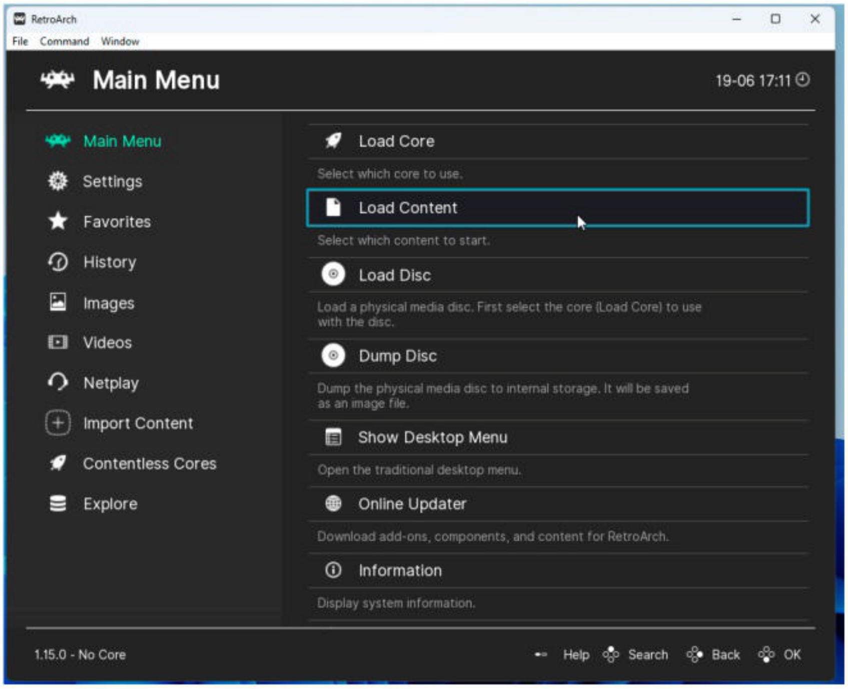
Developer: Elite Systems
Publisher: Elite Systems Ltd.
Genre: Action; Platform; Shooter
Play Mode: Single Player
Max Players: 1
Rating: Not Rated

Once set up, browse your games via LaunchBox's library view.

LET'S BREAK DOWN WHAT you need to enjoy retro gaming. First, you need some form of emulator for whatever platform(s) you wish to recreate. Virtually every home computer ever built has at least one emulator available for it, from popular classics like the Commodore 64 and Amiga to more obscure machines like the Welsh Dragon 32 and Japanese MSX family of computers. The same is true for games consoles, whether you're a fan of Sony, Sega, Xbox, or Nintendo. Long story short, whatever gaming platforms you've owned in your life, you'll almost certainly find an emulator for it.

If you spent most of your youth hanging out in arcades, you'll also be pleased to learn that it's possible to recreate classic arcade games on your PC too. The best platform for this job is MAME (www.mamedev.org), on which hundreds of classic games from the 70s onwards are widely available. There's even an emulator for playing classic PC games—see the 'Play Classic PC Games' boxout for full details.

If you're only interested in emulating one or two old machines, then the simplest thing to do is source only those emulators you need, then use them as and when you fancy a bit of nostalgic gaming. If this idea appeals, check out the box opposite on picking and choosing standalone emulators (along with some tips on which emulators work best).


RetroArch
File Command Window
Main Menu
19-06 17:11
Main Menu
Settings
Favorites
History
Images
Videos
Netplay
Import Content
Contentless Cores
Explore
1.15.0 - No Core
Help
Search
Back
OK

Load Core
Select which core to use.
Load Content
Select which content to start.
Load Disc
Load a physical media disc. First select the core (Load Core) to use with the disc.
Dump Disc
Dump the physical media disc to internal storage. It will be saved as an image file.
Show Desktop Menu
Open the traditional desktop menu.
Online Updater
Download add-ons, components, and content for RetroArch.
Information
Display system information.

RetroArch is a basic—but not particularly intuitive—frontend.

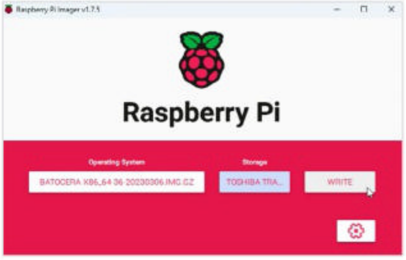
TIE MULTIPLE EMULATORS TOGETHER

Setting up and configuring individual emulators can also be a fiddly process, so if you fancy sampling from a wide range of platforms—those of friends and far-flung family members as well as your own collection—then you'll be pleased to learn there are umbrella projects out there that aim to provide a single frontend for all your retro gaming needs.

The process is driven by the Libretro API (www.libretro.com), which is designed to help developers create both games and emulators. Libretro can package both games and emulators into single files, which can then be organized under a single package for easy access. These files can then be packaged together under a single 'frontend' application to provide a consistent end-user experience that covers all your retro-gaming needs.

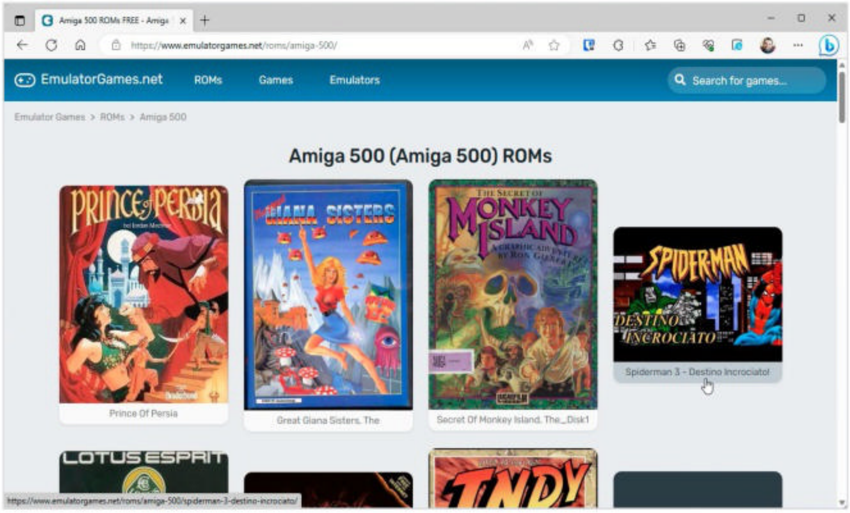
Libreto also comes with an official 'reference' frontend: RetroArch (www.retroarch.com). This is available on all major desktop, mobile, and even console platforms—there's even an online version (https://web.libretro.com) you can run in your browser. The aim of Retroarch is to keep everything organized in a single location while providing you with a relatively consistent user experience—at least up to the point where you launch each emulator. On top of this, frontends also strive to simplify the often-awkward task of sourcing files and configuring them to get each emulator up and running.

RetroArch is powerful, but can be off-putting. To make things more complicated, you'll find another level of frontends that let you combine RetroArch with other gaming platforms (such as Steam) to provide another single layer of organization for the games on your PC. One such example—EmulationStation—we'll be showcasing with our retro-gaming OS, but unfortunately the desktop version (www.es-de.org) is quite fiddly to implement and set up.


Raspberry Pi Imager v1.7.5
Raspberry Pi
WRITE

Operating System: BATOCERA X86_64 36 20230306.IMG.GZ
Storage: TOSHIBA TRA...

Create your Batocera boot media using the Raspberry Pi Imager tool.


Amiga 500 ROMs FREE - Amiga
https://www.emulatorgames.net/roms/amiga-500/
EmulatorGames.net
ROMs
Games
Emulators
Search for games...
Emulator Games > ROMs > Amiga 500
Amiga 500 (Amiga 500) ROMs
Prince Of Persia
Great Giana Sisters, The
Secret Of Monkey Island, The_Disk1
Spiderman 3 - Destino Incrociato!
https://www.emulatorgames.net/roms/amiga-500/spiderman-3-destino-incrociato/

You'll find most classic games available to download online.

© RETROARCH,EMULATORGAMES, RASPBEERY PI FOUNDATION

INCORPORATE EMULATORS INTO WINDOWS

Fortunately, there's a much easier way to provide a user-friendly platform for all your emulation needs in Windows, and that's through the LaunchBox frontend (www.launchbox-app.com). LaunchBox exists in paid-for and free forms, but for retro-gaming purposes, the free version does everything we need, and with a lot less hassle than EmulationStation, never mind RetroArch itself.

After downloading and installing (ignore the SmartScreen filter warning—it's perfectly safe), LaunchBox will automatically load to prompt you to populate your games collection from a variety of different sources—retro-gamers will be primarily interested in the first option: Import ROM Files, so select it.

You'll now be guided through a wizard that will ask you to select the files (or folder full of files) to import—this must contain ROMs for the same platform. But now you're asking yourself an awkward question: Where do I get these ROMs from?

The answer, of course, lies with the internet, but before we proceed, it's worth noting that many of these games are still considered under copyright. To stay on the right side of the law, it's expected that you own a physical copy of the game in its original form—disk, cassette, or cartridge. This has no bearing on whether you can download and play these games, but we're going to assume that—like us—you have copies of old classic games, computers, and consoles still gathering dust somewhere.

There are several sources of ROMs online. There are several multi-platform sites like EmulatorGames (www.emulatorgames.net/roms/) and Planet Emulation (www.planetemu.net). The former has a relatively small library of games, but spans a wide range of platforms; Planet Emulation focuses on the most popular models, but has collections spanning thousands of titles. It's all in French, however—browse by platform, download type (such as games or applications), and download format, then go through an A-Z list. Click an entry, followed by Télécharger, to download it.

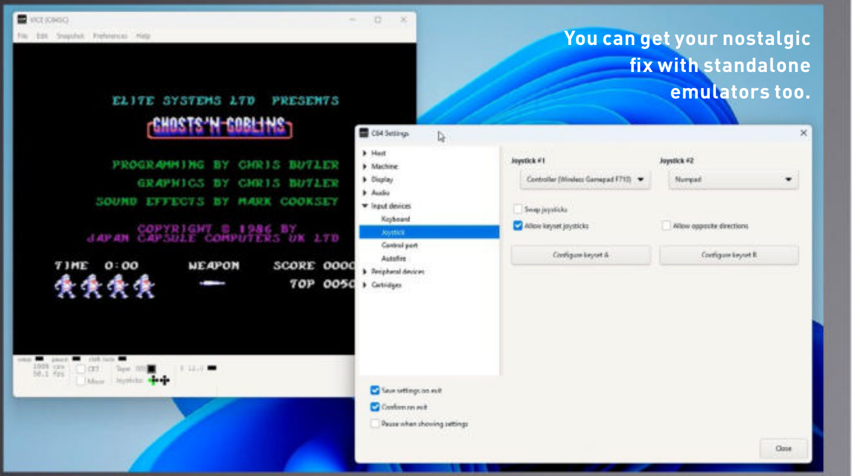
ADD GAMES TO LAUNCHBOX

Once you've download a selection of games for a single platform, return to LaunchBox, and point it at this folder before clicking Next. Confirm the computer/console model (it should be automatically detected by filetype), and click Next. You'll be given the option of letting LaunchBox automatically download and configure RetroArch, or you can manually choose an emulator if you prefer.

In most cases, choose the RetroArch option. If prompted, select which emulator to use (such as puae for the Amiga), then choose how you want your game files organized (copying into LaunchBox's own folder is the logical option). Allow LaunchBox to look for metadata (and choose what artwork to use), and we also recommend downloading bezels to make the gaming experience more attractive. Tweak any custom settings offered (if in doubt, leave untouched) and then LaunchBox will scan the folder and present you with a list of games it has found. Click Finish to complete the import wizard.

LaunchBox will now download, install, and configure RetroArch. When it's done, you'll see your games displayed on the main LaunchBox screen. Select one for details, or double-click it to launch the game.

STANDALONE EMULATORS



Joystick #1: Controller (Wireless Gamepad F710)

Joystick #2: Numpad

☐ Swap joysticks

☑ Allow keyset joysticks

☐ Allow opposite directions

☑ Save settings on exit

☑ Confirm on exit

☐ Pause when showing settings

You can get your nostalgic fix with standalone emulators too.

If your nostalgic yearnings only venture as far as one or two computers or consoles from yesteryear, then both Batocera.linux and LaunchBox might be overkill. All you need to do is source one emulator for each platform you want to recreate, then configure them directly. That would be simple enough if there was a single emulator for each platform, but when the Commodore 64 has 16 different options to choose from, how do you know which one to try?

A good starting point is EmuGen (https://emulation.gametechwiki.com)—select your computer or console from the list, and it'll display a list of emulators, complete with a 'Recommended' column helping you narrow down which ones are worth checking out. Simply click the version number of 'Latest Version' to go direct to its home page.

If that is too much hassle, here's a list of recommended emulators for gaming platforms that captured the US public back in the 80s and 90s. First up is VICE (https://vice-emu.sourceforge.io), which can emulate a wide range of early Commodore machines, from the PET to the C64, VIC20 and C16. The GTK3VICE-3.7-win64.zip build is best for most people's needs.

Move into the 16-bit era, and we recommend Hatari (https://hatari.tuxfamily.org/) for the Atari ST (and its successors, the STE, TT, and Falcon), and WinUAE (www.winuae.net) for all flavors of the Commodore Amiga, including the A500 and A1200 models.

When it comes to gaming consoles, Mesen (www.mesen.ca) covers Nintendo's NES and SNES models, while BlastEm (www.retrodev.com/blastem/) is popular for the Sega MegaDrive. Don't forget MAME (www.mamedev.org), which emulates classic arcade games of yesteryear for those who want to relive hours spent in arcades without having to find a fresh stash of quarters.

BUILD A RETRO-GAMING PC

Today's small-factor computers are the perfect candidates for building a dedicated PC for retro gaming. They're small enough to tuck under your big-screen TV and come with all the ports you need to plug in controllers, keyboards, and mice.

But what model should you buy? The good news is that the latest and most powerful CPUs aren't required for anyone looking to emulate classic platforms from the 70s, 80s, and early 90s. A Raspberry Pi 3 can handle these emulators with relative ease, so when shopping for a mini PC, you can keep your cost below $250 by opting for the low-powered Celeron N5105 chip like this example from Intel ($242, www.newegg.com/p/2SW-000B-003S1).

If you can afford a better CPU, then you can expect to bring more recent consoles into play, including many manufactured in the 2000s, like the PS2, Nintendo Wii U, and Xbox. For example, the new Beelink SER5 Mini PC, powered by a Ryzen 7 5800H, 16GB RAM and 500GB NVMe drive, can be had for under $350 (www.amazon.com/dp/B0BWDJDMP8/), and can run both GameCube and PS2 games at 1080p.

Don't buy blind, however—be sure to Google any models that catch your eye with the keywords 'batocera' or 'emulation' to see the comments and reviews. YouTube is packed full of video reviews, allowing you to see up close how games look and perform on specific models, while another good resource can be found at the Batocera wiki (https://wiki.batocera.org/usff_nuc_mini_pcs). Although its information is outdated, it contains good advice about what limitations to expect (some early Beelink models don't support USB or SD card booting, so invest in an m2 SSD enclosure ($20-30 on Amazon) so you can flash Batocera.linux directly to the internal drive.

A NUC PC is the perfect dedicated retro gaming machine.

CONFIGURE YOUR CONTROLLER

As things stand, you can now play games using your mouse and keyboard. But what about gaming controllers? LaunchBox will work with any controllers visible in Windows, so if necessary, install the drivers for your controller before proceeding. Once done, open LaunchBox's Tools menu and choose Options, then scroll down to the Game Controllers section. Verify that your controller is present, then check 'Enable Game Controllers' and select your controller from the list before clicking OK.

When you've had enough of a game, press Alt + F4 or Esc twice to quit and return to the main library screen. To add more games to RetroArch, click the menu button next to its name, and choose Tools > Import to access the submenu, where you'll find options for incorporating more ROMs, MAME arcade files, and DOSbox-compatible games too.

While some emulators come with BIOS/firmware/operating system supplied, others may require additional files—for example, when setting up an Atari ST, you'll be prompted for a tos.img file. Libreto supplies most of these itself—get them from https://github.com/Abdess/retroarch_system if prompted—and then hopefully the games will run fine. If you run into problems, skip to the 'Configure games and troubleshoot' section for more advice, or check out its troubleshooting forums (https://forums.launchbox-app.com/forum/64-troubleshooting/), in particular the first post, where you'll find links to helpful tutorials and tips.

A GAMING OPERATING SYSTEM

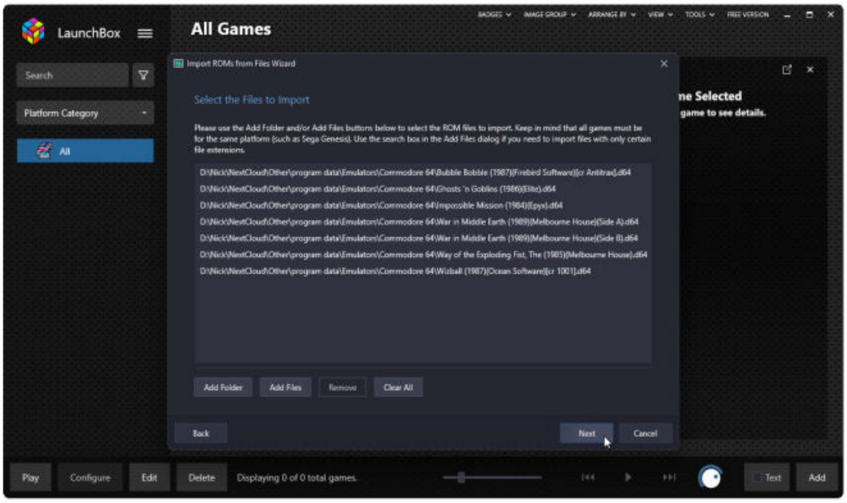
We'll leave you to continue playing with LaunchBox and move on to configuring a whole retro-gaming operating system for your pleasure, one that's installed directly to USB flash drive for portable use, or SD card or internal hard drive if you want to dedicate a single machine solely for retro gaming without any other distractions (see the box). That OS is the excellent Batocera.linux (https://batocera.org/).

Batocera.linux works across a wide range of systems, from Intel-powered desktops, laptops, and NUC PCs to various handheld platforms, as well as the likes of the Raspberry Pi, Odroid, and Rockchip. If you choose the portable option, everything is contained on the flash drive, making it easy to set up and configure Batocera on your desktop PC, then take it with you to play on your laptop, or even a friend or family member's PC, without having to set it up again.

The bare minimum you need to run Batocera.linux is a USB flash drive (or micro-SD card) that's at least 16GB in size. You'll also want at least one game controller—see https://wiki.batocera.org/supported_controllers for a list of supported controllers, which covers most common types. If you're installing it on a NUC PC to keep under the TV, we'd also recommend investing in a wireless keyboard/trackpad like the Logitech K400 Plus ($27.99, www.logitech.com) for older games that used computer keyboards or mice rather than joysticks. If you plan to install it directly to an internal hard drive, you'll also need a USB enclosure to temporarily house the drive in, so the OS can be 'flashed' directly to it.

SET UP BATOCERA.LINUX

Once you've got your hardware set up, your next task is to copy Batocera to your boot medium of choice. First, head over to https://batocera.org/download to obtain the relevant build ('Desktop, Laptop, NUC and Intel-based Apple Computers' in most cases). This is a hefty 2.6GB download, so while you wait for it to download to your PC, go to www.raspberrypi.com/software/ to download and install Raspberry Pi



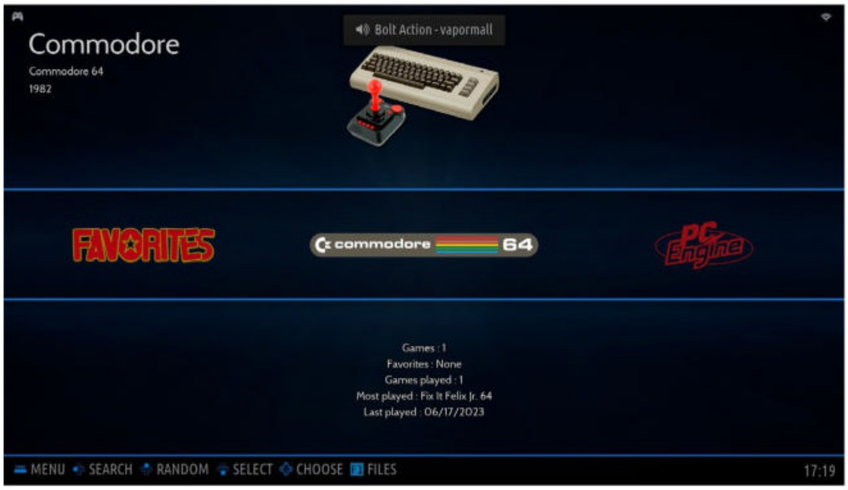
Select the Files to Import

Please use the Add Folder and/or Add Files buttons below to select the ROM files to import. Keep in mind that all games must be for the same platform (such as Sega Genesis). Use the search box in the Add Files dialog if you need to import files with only certain file extensions.

```
D:\Nick\NextCloud\Other\program data\Emulators\Commodore 64\Bubble Bobble (1987)(Firebird Software)[cr Antitrax].d64
D:\Nick\NextCloud\Other\program data\Emulators\Commodore 64\Ghosts 'n Goblins (1986)(Elite).d64
D:\Nick\NextCloud\Other\program data\Emulators\Commodore 64\Impossible Mission (1984)(Epyx).d64
D:\Nick\NextCloud\Other\program data\Emulators\Commodore 64\War in Middle Earth (1989)(Melbourne House)(Side A).d64
D:\Nick\NextCloud\Other\program data\Emulators\Commodore 64\War in Middle Earth (1989)(Melbourne House)(Side B).d64
D:\Nick\NextCloud\Other\program data\Emulators\Commodore 64\Way of the Exploding Fist, The (1985)(Melbourne House).d64
D:\Nick\NextCloud\Other\program data\Emulators\Commodore 64\Wizball (1987)(Ocean Software)[cr 1001].d64
```

Displaying 0 of 0 total games.

LaunchBox makes it easy to import games by platform.



Games : 1
Favorites : None
Games played : 1
Most played : Fix It Felix Jr. 64
Last played : 06/17/2023

Batocera comes with several emulators and games ready to go.

Imager, the tool that will transfer it to your bootable medium.

Once the image is downloaded, launch RPi Imager, then click 'Choose OS' followed by 'Use custom' before selecting the .img.gz file you just downloaded. Make sure your chosen destination (USB flash drive, microSD card reader, or external USB enclosure) is selected before clicking Write. Wait for the image to be written to the drive (and verified), and once complete, close the installer.

Now is the moment of truth: if necessary, fit the internal hard drive back into your retro-gaming PC or slot the SD card into your handheld emulator, RPi or similar device. If you're running Batocera from your main PC, leave the drive plugged in, and reboot.

FIRST-RUN SETUP

When Batocera.linux boots for the first time, it'll first resize the drive's partition to fill all available space, and provide you with plenty of room to store your games and ROM files. It'll then reboot to its loading screen, and eventually place you at the main screen for the EmulationStation frontend. You'll see that several emulators are already on show, which you can cycle through using either your game controller or the cursor keys on your keyboard.

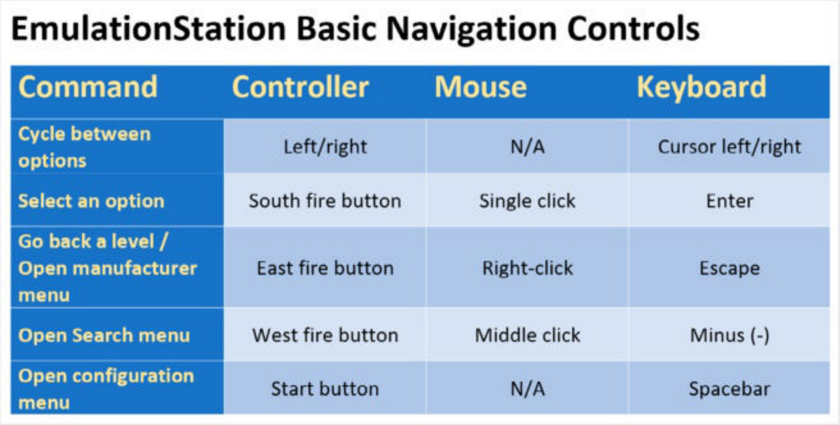
If you're lucky, your game controller should be configured to work out of the box—otherwise, hold a button when prompted to go through a wizard that will allow you to map controls to the buttons, joypads and—if applicable—analog sticks on the controller. Once done, navigation is a mixture of controller, mouse, and keyboard, but primarily controller. It pays to understand the basics of navigating the EmulationStation frontend, which is why we've put together a screenshot that offers a cheat guide to basic navigation using the controller, mouse, or keyboard.

NAVIGATE EMULATIONSTATION

Returning to EmulationStation, you'll see several emulators have been preconfigured to give you a flavor of what's available and how it works—they include that ubiquitous 80s machine, the Commodore 64 along with the classic Nintendo ES, Gameboy Advance handheld, and two less well-known entries titled Ports and Pygamer. For a description of these, as well as a comprehensive list of all supported platforms on Batocera, consult its wiki (https://wiki.batocera.org/systems).

Start by selecting one of the listed platforms using the south fire button and a list of games for that emulator will be displayed. Click one and your chosen emulator will load itself followed by the game itself. You should now be able to play the game using your controller or—if applicable—keyboard/mouse, but how do you quit when you're done?

It's worth noting that when you configure a controller, you'll be prompted to set up a special hotkey—typically Select if it exists, but any unused button will do. Creating this allows you to use hotkeys on your controller to configure, reset, or exit



EmulationStation Basic Navigation Controls

Command	Controller	Mouse	Keyboard
Cycle between options	Left/right	N/A	Cursor left/right
Select an option	South fire button	Single click	Enter
Go back a level / Open manufacturer menu	East fire button	Right-click	Escape
Open Search menu	West fire button	Middle click	Minus (-)
Open configuration menu	Start button	N/A	Spacebar

Save time by learning how to get around Batocera quickly.

© LAUNCHBOX, BATOCERA

your emulator—the exact behavior will depend on the emulator in question, but basically the hotkey is used in conjunction with the four fire buttons or Start button to trigger certain actions. However, there's one fail-safe keyboard combo that will always come to your rescue, regardless of the game you're playing: Alt + F4 will force quit the emulator and return you to the main game menu.

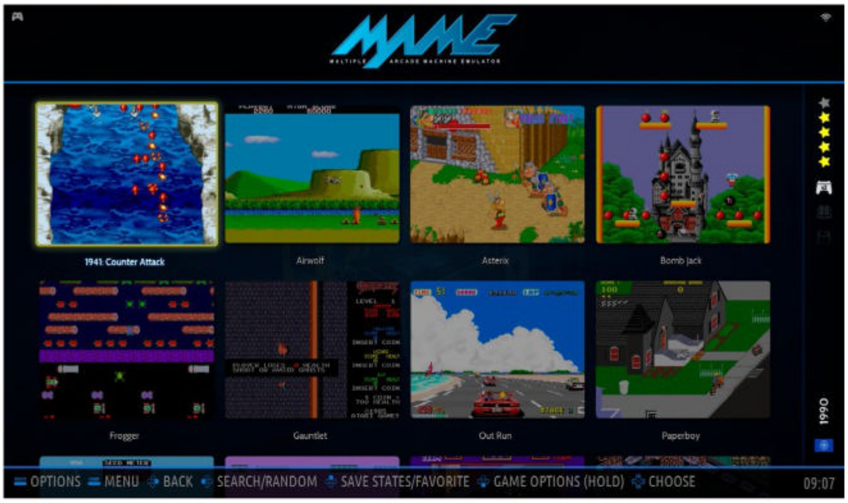
CONFIGURE BATOCERA.LINUX

Pressing the Start button on your controller opens the main Batocera menu. When navigating, be patient: there may be a slight lag in selecting an item and it being enabled or popping up—particularly on low-powered machines, like the Raspberry Pi.

Ignore the Kodi Media Center option at the top, and instead focus on the other options. If you want to connect your retro-gaming machine to a wireless network, make sure you head into Network Settings. Start by flicking the 'Enable Wifi' switch to On—this will then reveal WiFi SSID and WiFi Key options. Select the first to browse a list of detected networks and select yours. Once done, enter the code into WiFi Key using your controller (in conjunction with an on-screen keyboard) or just your keyboard. Select the check key and hit Enter, then wait for the WiFi Enabled box to pop up, then select Network Settings again to verify your gaming machine is connected (and so able to easily receive ROMs and game files over the network, plus download metadata from the internet).

Speaking of metadata, the Scraper section is where you can quickly scan through all your game titles to download artwork and metadata to help organize them in your ever-growing library. You need to define a default scraper (the default ScreenScraper is geared towards European audiences, so we suggest choosing TheGamesDB instead, which has the added advantage of being more comprehensive). Once set up, choose 'Scrape Now' to quickly find metadata for titles that haven't got any.

Other options are self-explanatory—use Controller & Bluetooth Settings to reconfigure your controller or add others for multi-player gaming, or navigate to System Settings > Audio Output to select your HDMI connection if you can't hear any sound. One other area of interest: Updates & Downloads provides not just a source of keeping Batocera.linux and your emulators updated, but it offers a 'Content Downloader' too, where you'll find freely distributed content, including lots of games across multiple platforms. Some—such as Tic-80 games—will automatically add the required platform or emulator as required.



Each emulator has its own dedicated page listing all available games.

000000
BONUS: 3500
L=01
OIL
POWER
RESET
SUPER Famicom
SUPER Famicom

Donkey Kong is one of the few pre-installed games with Batocera.

ADD MORE EMULATORS AND GAMES

There's no need to go sourcing and setting up emulators for Batocera—a wide range are installed alongside the main program, thanks largely to its underlying support for Libreto; indeed, some platforms like the Atari ST have multiple emulators (Libreto and non-Libreto variants in the case of the ST) to choose from.

Emulators will remain hidden from Batocera until you've copied across some games into the relevant folder and—if necessary—obtained the machine's underlying operating system as a ROM (return to https://wiki.batocera.org/systems for confirmation about whether a specific platform requires this). Getting files copied across is relatively straightforward: if you're running Batocera on your PC, you can copy files across via USB—plug it into your computer and then press F1 on the main screen to open Batocera.linux's built-in file manager.

A quicker method is to copy files via your network. By default, Batocera makes all key folders available via a single 'share' folder. If it doesn't automatically show up under Network, try typing one of the following into File Explorer's Address Bar: \\BATOCERA\share or \\192.168.x.y\share, where 192.168.x.y is the IP address displayed under Network Settings.

Start by entering the bios folder and double-clicking the readme.txt file to discover what operating system file(s) each emulator supports. If your machine isn't listed, skip to the next section. If it is listed, you should be able to source most required files via https://github.com/Abdess/retroarch_system, but otherwise you'll need to engage in some detective work to find the files (Planet Emulator is a good place to start).

© BATOCERA

Once sourced, copy the file(s) into this folder before navigating up one level to open the roms folder, where you'll see folders for each machine. Open this to read an _info.txt file that reveals the file types the emulator supports. Copy the relevant game files into here—they can be organized into sub- folders if you wish.

Press F4 on the main EmulationScreen, and your PC will scan for new content. All being well, your new machine (and games) will be ready. Select a game and tap the South fire button to launch it—if you get a warning about missing BIOS file(s), but have already sourced at least one file, tap Yes to continue to boot. If the file is compatible with your game, you should have no issues.

For more on emulator ROMs and game files, keep reading, and don't forget to download your metadata—if any titles were missed out when you scraped earlier, you can scrape for individual titles across all supported search engines: select the game in the list, then hold down the south fire button to bring up its 'Advanced Game Options' menu. Choose Scrape to search for a possible match. If one is found, select it from the list, and hit the south fire button. If no match is found, select Input to enter different search terms, and try again.

CONFIGURE GAMES AND TROUBLESHOOT

Whether you're using LaunchBox or Batocera, there will be times when emulators don't perform how you want—or they might exhibit stability problems. When downloading games, check if the download page offers any clues—you may need a specific version of the machine's OS (kick34005.A500 for the Amiga 500, or tos102uk.img for a UK-released game on the Atari ST), for example.

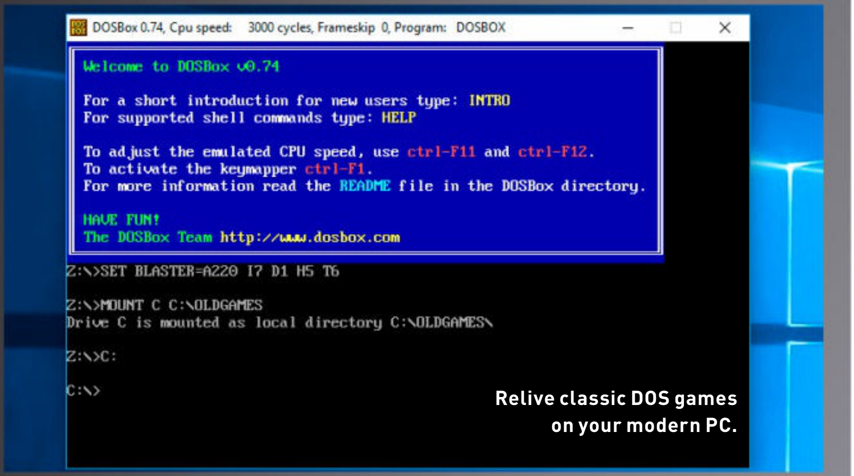
These files can be found online—often through Planet Emulator (see above)—but the same legal caveat applies, in that you should have access to a legitimate copy of the original operating system—typically in the form of the actual computer gathering dust in your loft or basement. Copy these files to the C:\Users\[username]\LaunchBox\Emulators\RetroArch\ system folder in LaunchBox, or the bios folder in Batocera.

Emulators can be configured in two places. You can start by seeing what options RetroArch has—for example, by allowing you to run the game using different settings. Batocera users can do this by pressing Start, then navigating to Game Settings > Per System Advanced Configuration and selecting your machine. Here, you can do things like force EmulationStation to use a specific emulator if more than one is available or play around with video and audio settings if you run into display problems.

These settings can also be set for individual games—select the game and hold the South fire button to bring up its own menu. Selecting 'Advanced Game Options' from here allows you to make the same changes, except they'll only apply to the selected game. LaunchBox users can access similar options by selecting a game and pressing Ctrl + E.

The other place to configure a game is in the emulator itself when it's running. Consult the documentation for how this is done and what options are available—such as swapping floppy disks when loading multi-disk games, or choosing a different TOS version if you're running the Hatari emulator for the Atari ST. When tweaking your settings, look for an option to save any configuration file—in most cases, changes won't be retained the next time you open the emulator otherwise.

PLAY CLASSIC PC GAMES


DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: DOSBOX

```
Welcome to DOSBox v0.74

For a short introduction for new users type: INTRO
For supported shell commands type: HELP

To adjust the emulated CPU speed, use ctrl-F11 and ctrl-F12.
To activate the keymapper ctrl-F1.
For more information read the README file in the DOSBox directory.

HAVE FUN!
The DOSBox Team http://www.dosbox.com
Z:\>SET BLASTER=A220 I7 D1 H5 T6

Z:\>MOUNT C C:\OLDGAMES
Drive C is mounted as local directory C:\OLDGAMES\

Z:\>C:

C:\>
```

Relive classic DOS games on your modern PC.

We've covered virtually every home computer and gaming console platform in this feature, but what about your classic PC games? Chances are that you've spent a fair portion of your life playing on your PC—and many old favorites may now be gathering dust on your shelves as new models and updates to Windows rendered them obsolete. The good news is that there are ways to resurrect these too.

For those who remember 16-bit PC computing and DOS, the obvious choice is DOSBox (www.dosbox.com), which works brilliantly with old classics from the 90s. Install the program to the root of your C drive, then create a folder alongside called oldgames, into which you copy the games you own from your original disks and CDs (or from websites like www.dosgames.com) into their own subfolders.

Next, type 'dosbox' into the Search bar and click DOSBox to launch it. Type MOUNT C C:\OLDGAMES into the window that appears and press Enter. When drive C is confirmed as mounted to the oldgames directory, type C: and press Enter. Type CD followed by the name of the subfolder containing your game and press Enter, then type the game executable and press Enter to launch it. When the game starts, click inside the window to capture the mouse. Exit by pressing the Windows key.

DOSBox is also included with Batocera, although see https://wiki.batocera.org/systems:dos for platform-specific instructions on using it. It can also be incorporated into LaunchBox. And what about newer, 32-bit games? If you have access to copies of old versions of Windows, then the simplest solution is to create a virtual machine running your target version of Windows in VirtualBox (www.virtualbox.org), then install the game in there for you to play through the virtual machine itself.

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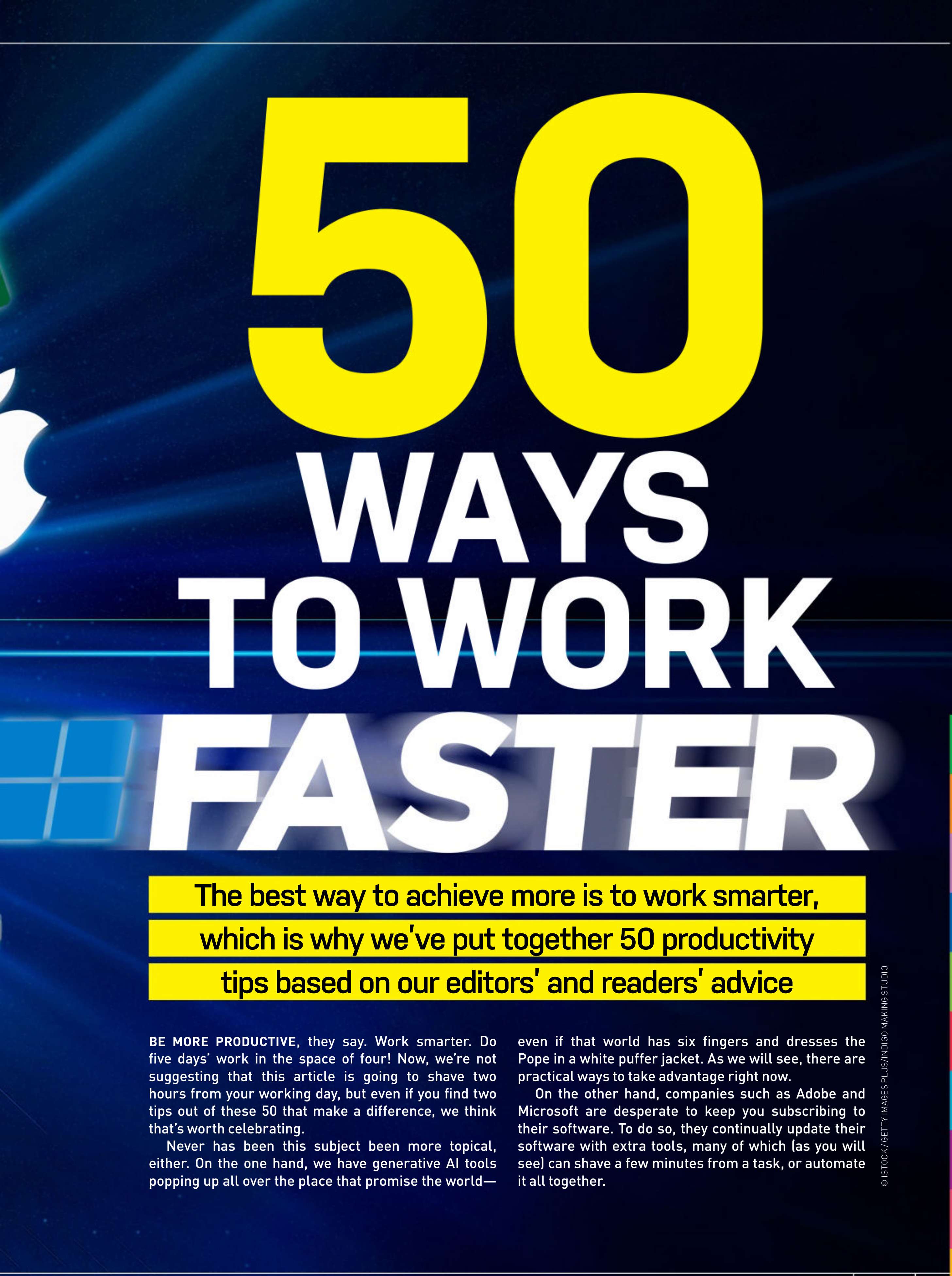


50 WAYS TO WORK FASTER

The best way to achieve more is to work smarter, which is why we've put together 50 productivity tips based on our editors' and readers' advice

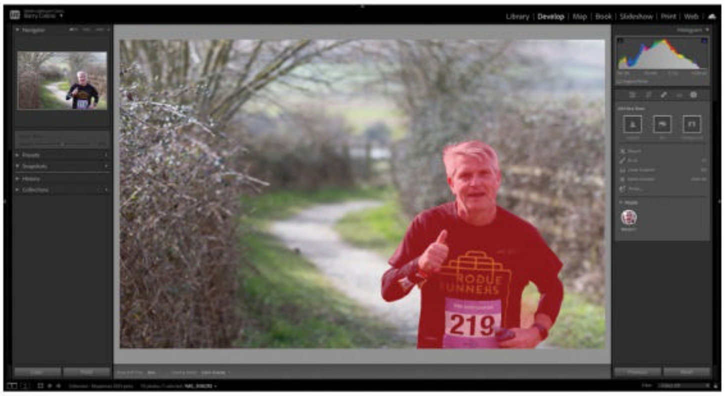
© ISTOCK / GETTY IMAGES PLUS/INDIGO MAKING STUDIO

BE MORE PRODUCTIVE, they say. Work smarter. Do five days' work in the space of four! Now, we're not suggesting that this article is going to shave two hours from your working day, but even if you find two tips out of these 50 that make a difference, we think that's worth celebrating.

Never has been this subject been more topical, either. On the one hand, we have generative AI tools popping up all over the place that promise the world—even if that world has six fingers and dresses the Pope in a white puffer jacket. As we will see, there are practical ways to take advantage right now.

On the other hand, companies such as Adobe and Microsoft are desperate to keep you subscribing to their software. To do so, they continually update their software with extra tools, many of which (as you will see) can shave a few minutes from a task, or automate it all together.

ADOBE LIGHTROOM CLASSIC



It's now much easier to select people in an image in Lightroom.

QUICKLY SELECT PEOPLE

If you've taken a portrait, it's easy to select the person without having to brush around them first. Open the image in the Develop panel, and then select the Masking tools, which are found by clicking on the circular icon under the histogram. You should see small circular thumbnails of any people in your image in the right-hand pane. Click on them, and the red mask highlighter will appear over the person in the image.

That should open a sub-menu that allows you to mask only certain body parts, such as hair, teeth, face, skin, or lips. Select the appropriate body part or the entire person, then click Create Mask. Now, you can make isolated adjustments to exposure, colors, saturation, and so forth to get the desired effect.

BRIGHTEN SKIES WITH EASE

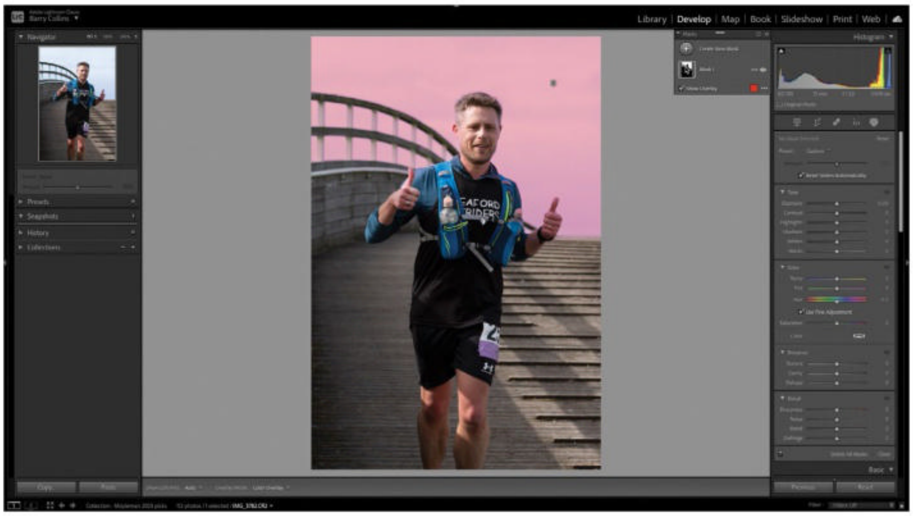
Once again, open your landscape image in Develop mode and click on the Masking tools. This time, select the Sky button from the right-hand pane. Once the sky has been selected, you can adjust the temp, tint, and hue settings until your dull gray sky is a more pleasing blue.

The advantage of using the Sky mask tool rather than brushes is that the selection is accurate, even picking out the sky in the gaps between the bridge rails in our photo, so you don't end up with parts of the image being wrongly colored or having to spend ages fine-tuning the mask.

CONTENT-AWARE REMOVAL OF STRAY OBJECTS

If you have a stray crisp packet on a beach or a distracting interloper in a landscape, you can swiftly brush them out of history. In the Develop mode, click on the sticking plaster tool in the right-hand pane, and make sure content-aware removal is selected at the top of the pane that opens—it's the icon that looks like an eraser.

Now, brush over the part of the image you wish to vanish away, using the mouse scroll wheel to adjust the size of the brush, if necessary. When you're done, Lightroom should hopefully have removed the miscreant and filled in the background with something suitable.



Change the color of the sky using Develop mode.

AUTOMATIC PEOPLE TAGGING

Automatic people tagging makes finding people in a big library easier.

In the Library panel, press "O" on your keyboard to enter People mode. You should now be presented with a sea of thumbnails showing the faces of anyone in the open picture folder or collection. Lightroom does a pretty good job of matching faces, batching together all the pictures containing a particular person. Enter the person's name beneath their thumbnail, and not only will all the pictures in that folder/collection be appropriately tagged, but Lightroom will attempt to identify that same person in other folders/collections, too.

LENS CORRECT ON IMPORT

Lightroom now applies automatic lens correction for modern mirrorless cameras, but doesn't for older DSLR models.

To have all of your images lens-corrected in one hit, you can create a preset that does this at import. Launch Lightroom with the Develop panel open on an image to which you've already applied lens correction, and then click Develop | New Preset from the application dropdown menu. Select the option to Check None and reselect the options you want under Lens Correction (such as chromatic aberration and enable profile corrections). Now, call this preset "Lens correction", and click Create.

The next time you import, you'll be able to save time by selecting the Lens correction preset.

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MICROSOFT EXCEL

DEAL WITH COMMA-SEPARATED VALUES

De-mangle badly formatted data, such as a list of names in the "Collins, Barry" format, and break it down into first name and surname with the new TEXTBEFORE function.

Let's say the name above was printed in cell A2. To extract the surname alone, you'd enter the following formula:

`=TEXTBEFORE(A2, ",")`

A2 is obviously the cell we're targeting and the "," part specifies the delimiter, in this case the comma between surname and first name. The TEXTAFTER function works in a similar way.

INSERT DATA FROM A PHOTO

If there's a table in a printed document that you don't want to go through the hassle of entering manually, you don't have to. Excel now offers the option to insert data from a photo, letting you snap the table using the camera on your smartphone and upload it to Excel. You'll find the Insert From Picture option in the Insert tab of the Ribbon.

You can review and correct the data before Microsoft imports it—the cleaner the photo, the better. We were able to grab data off a website by snapping our monitor, but scans or screenshots worked even better. It's not flawless, but it's much quicker than doing it by hand.

GET AI TO WRITE YOUR FORMULAE

If you struggle to wrap your head around Excel formulae, ask an AI to help you. Services such as ChatGPT—now freely accessible via Bing in the Edge browser—are able to write Excel formulae for you.

I asked Bing to help me create a formula that counts how many times the word "Google" appears in a spreadsheet. It replied:

"You can use the COUNTIF function to count the number of times a specific value appears in a range of cells. For example, if you want to count the number of times "Google" appears in cells A1 to A10, you can use the following formula: `=COUNTIF(A1:A10,"Google")`. This will return the number of cells in the range A1 to A10 that contain the text "Google"."

QUICKLY SET GOALS

Let's say your website has a traffic target of an average of 250,000 visitors per month in Q1. You know the figures for January and February, but want to know how many visitors you need in March.

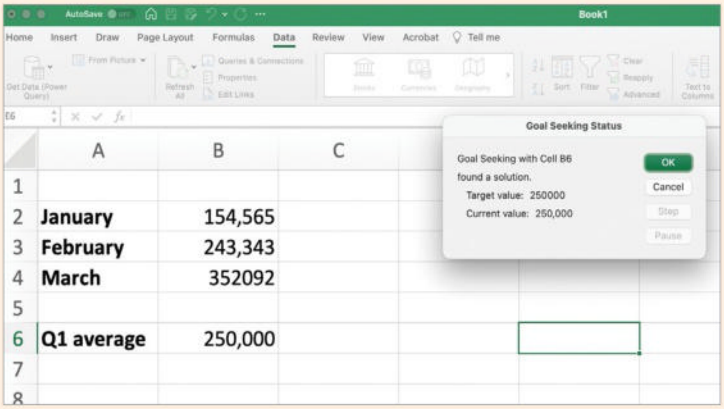
Excel has a goal-seeking feature that can get you this answer. Open the Data tab, click What-if Analysis, and choose Goal Seek from the dropdown. In the example below, we need to get our Q1 average in cell B6 up to 250,000, so we select $B$6 as the Set Cell, enter 250,000 as the To Value, and it's the figure in cell B4 that we need to change to know what traffic we need to achieve in March. Press OK, and Excel will do the sums and spit out the goal.

You can later replace the goal figure with the actual figure and the spreadsheet will recalculate the true average.

FILTER HUGE SHEETS

Let's say you have a spreadsheet containing every transaction from an online store in the past six months. You can use filters to show only the sales of certain products, sales within a given month, sales that exceed $100, and so forth.

You can apply filters by clicking Sort and Filter on the Home tab, and then Filter. A filter dropdown will appear at the top of each column, where you can determine what to filter by. You can filter on more than one column, so if you need to find all sales that exceeded $100 in August, you just need to adjust the filters at the top of the date and transaction value columns.



Goal Seeking Status

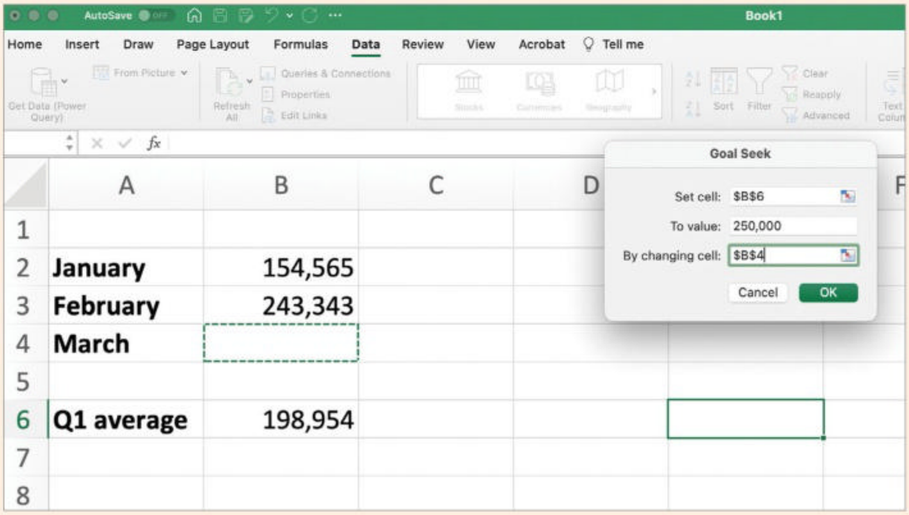
Goal Seeking with Cell B6 found a solution.

Target value: 250000

Current value: 250,000

	A	B	C
1			
2	January	154,565	
3	February	243,343	
4	March	352092	
5			
6	Q1 average	250,000	
7			

Excel's goal-seeking feature is a great way to set targets.



Goal Seek

Set cell: $B$6

To value: 250,000

By changing cell: $B$4

	A	B	C	D
1				
2	January	154,565		
3	February	243,343		
4	March			
5				
6	Q1 average	198,954		
7				
8				

Goal Seek will do the sums for you.

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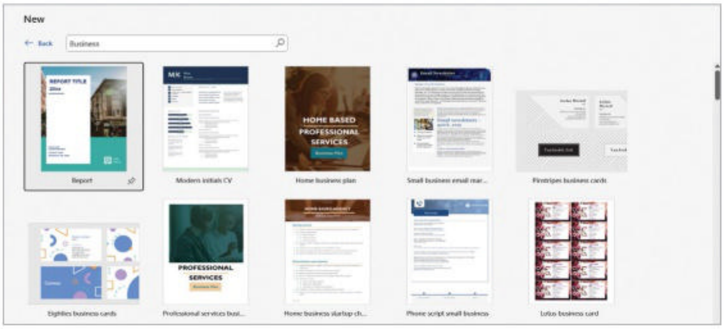
MICROSOFT WORD

USE WORD'S STYLE SHEETS

Word's Style Sheets are powerful, yet widely ignored, according to reader, Geoff Campbell.

"I do a lot of load tests, for example, with 40-page results reports in a nice, sober business layout, maybe 5,000-ish words and lots of supporting graphs," he wrote. "They all share exactly the same look, generated by the style sheet, so that reports from a decade or more ago are instantly recognizable against ones done last week, and I know that if I tweak a paragraph attribute, it will be reflected through the whole document instantly. It's a massive time-saver."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Save time by creating your own Word templates.

ROLL YOUR OWN WORD TEMPLATES

Martin Bailey advocates "roll your own templates", using them for documents that "I'm going to need again: add the headings and cover sheet, and save it as a template before adding any content". In addition, he uses ClipName to "turn filename paths into URLs or clickable Word links". This simple (and free) utility adds an extra item to Windows Explorer's right-click menu.

CO-AUTHOR DOCUMENTS

It isn't only Google Docs that lets you collaborate on documents in real-time. You've been able to co-author in Word since 2016, though encrypted document support took longer. Naturally, Microsoft insists the file is saved to OneDrive (or SharePoint Online), at which point you can invite people to collaborate via the Share dialog.

POWERPOINT

USER SURFACE EARBUDS TO CONTROL YOUR PRESENTATION

You can press the spacebar or mouse left-click to go to the next presentation slide, but for the last word in cool, use the Surface Earbuds ($200 from Microsoft). After pairing them with the Surface Audio app in Windows 10 or 11, you can then use gesture controls.

First, start a presentation (by pressing F5), then right-click on the slide. Under "Surface Earbuds Settings", choose "Use Gestures to Control Presentation". It will now work for all presentations.

The actions are intuitive: simply swipe forward or backward on the left earbud to, well, go forward or backward. You can double tap to play or pause videos, too.

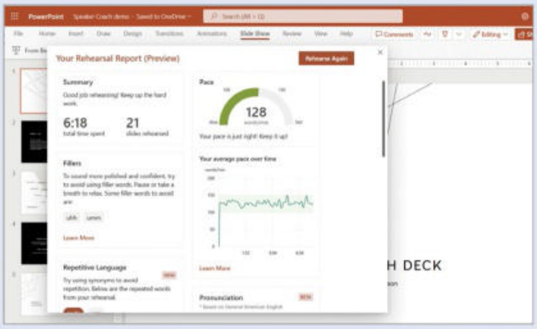
PRE-RECORD PRESENTATIONS

If you find yourself repeating the same presentation online over and over again, use the option in PowerPoint to record yourself doing it. You can still answer "live" questions at the end of the presentation, of course, or share it with your audience and let them view the session in their own time. Click the Cameo option from the Record ribbon, and you can insert yourself into the presentation complete with numerous effects and blurring options. It's all intuitive, so have a play and, when you're happy, click Export Video to share it with the unsuspecting world.

REHEARSE WITH SPEAKER COACH

This isn't a short-term time-saver; it's one for the long term. You see, Microsoft has a tool that allows you to rehearse your presentations in private, but Speaker Coach doesn't just sit there and watch; it gives you a report at the end of the presentation with feedback on your pitch, pacing, over-use of euphemisms, and much more besides.

To use Speaker Coach, open your presentation in PowerPoint for the web in Microsoft Edge. Obviously, you'll need to be signed in via your Microsoft account. Click on the opening slide, and then choose Slide Show from the Ribbon. Now, hit "Rehearse with Coach", and after giving Edge access to your microphone, talk away as you normally would. When the slideshow ends, you will be given a report, complete with surprisingly useful insights.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Your Rehearsal Report (Preview)
Rehearse Again
Summary
6:18
21
Pace
128
Your average pace over time
Fillers
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Repetitive Language
Pronunciation
H DECK

Speaker Coach will improve your presentation technique.

INSERT APPLE PHOTOS WITHOUT CONVERSION

Here's a quick tip for anybody who still converts Apple photos before inserting them into Office applications: you don't have to. In fact, ever since summer 2020, all the Office apps have supported HEIF and HEIC images (as taken by iPhones), so all you need to do is browse to the pics in question via the Insert tab (then select Pictures | From device).

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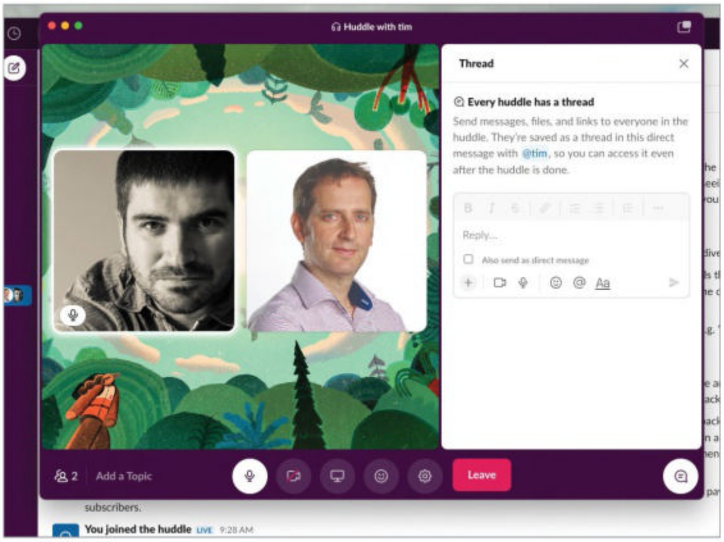
SLACK

MEET IN HUDDLES

Why spend 20 minutes trying to sort something out in text messages that you could have settled with a two-minute chat? Huddles are a clever solution to that problem.

Available in any Slack channel, they allow all members to quickly join an online call and discuss something. Anyone can dip in and out of a Huddle, and you don't have to set up invites or schedules. Just flick the Huddle switch at the bottom of the channel's menu, join in by voice or video, or type the command /huddle.

Our only criticism of Slack Huddles is that it's not always obvious when somebody has started one—the notifications could be better.



Every huddle has a thread

Send messages, files, and links to everyone in the huddle. They're saved as a thread in this direct message with @tim, so you can access it even after the huddle is done.

subscribers.

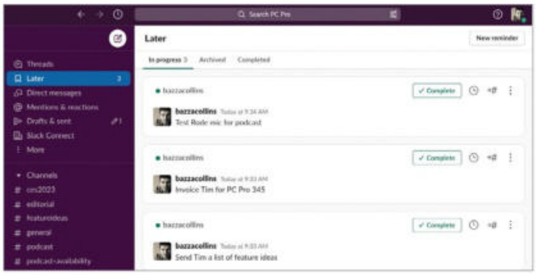
You joined the huddle

Huddles allow all members to join an online call.

CREATE A TO-DO LIST

Another of Slack's irritations is its immediacy: people see you're online and expect an immediate answer. That's not always possible, and it's easy to lose track of conversations. One way around this is by saving messages. Click on any message, and you'll see a small bookmark icon that allows you to save it. The sender doesn't see you've saved the message, but it's lodged in your saved message queue, creating a pseudo to-do list of messages to reply to when you have time.

If you need to create a to-do list item yourself, you can direct message yourself and then save that message.



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Test Rode mic for podcast

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bazzacollins
Invoice Tim for PC Pro 345

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bazzacollins
Send Tim a list of feature ideas

Create your own to-do lists using the bookmark icon.

INCLUDE CONVERSATION HISTORY

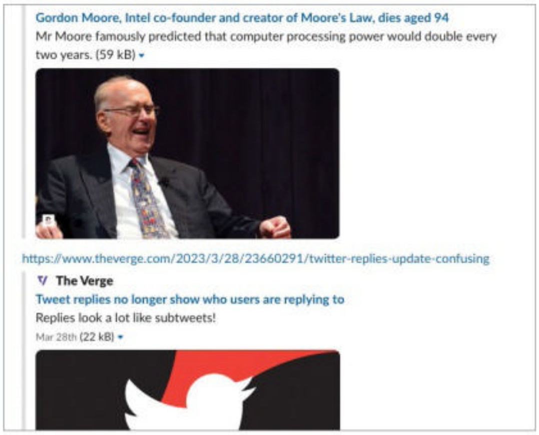
A lot of Slack communication takes place in DMs between a select group of team members. If you want to bring a colleague into the conversation, you would—until recently—have had to bring them up to speed on what's previously been discussed, as Slack barred them from seeing past conversations. Now, when you add a colleague to a DM group, there's an option to let them see previous conversations, meaning you can let them read back and bring themselves up to date. Just make sure there's nothing sensitive in there.

MASTER THE SLASH COMMANDS

If you're using Slack on desktop, the Slash commands can be extremely useful for performing quick actions without having to dive into menus.

Two of the commands we commonly use are /collapse and /expand. /collapse hides all in-line images and thumbnails that appear when someone shares a link in a channel, making it much easier to skim back through discussions, while /expand does the opposite.

Other useful commands are /remind to set a reminder for a @user, or a #channel and /status to quickly change your Slack status (such as "in offsite meeting"). The full list can be found at tinyurl.com/2zf4fuun.



Gordon Moore, Intel co-founder and creator of Moore's Law, dies aged 94

Mr Moore famously predicted that computer processing power would double every two years. (59 kB) ▾

https://www.theverge.com/2023/3/28/23660291/twitter-replies-update-confusing

The Verge

Tweet replies no longer show who users are replying to

Replies look a lot like subtweets!

Mar 28th (22 kB) ▾

Expand and contract images in links via slash commands.

SEND EMAILS TO SLACK

Slack was originally pitched as an email killer. It didn't, of course; it just created another way to communicate. That means there are still times when messages relevant to your Slack conversations are received via email, especially those from external clients who don't use Slack.

However, this is a convenient way to forward emails to Slack channels or conversations so that you can discuss, say, project feedback from clients with the group. To do this on Slack's desktop app, open the channel/conversation that you would like to send the email to, and click the down arrow next to the channel/conversation's title at the top of the screen. Now, select the Integrations tab, and then "Send emails to this channel". When you click that, you will be given a long, obscure email address that you can forward messages to.

Slack can handle attachments, so you don't need to worry about PDFs or suchlike being left behind. This feature is only available to paying subscribers.

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OTTER

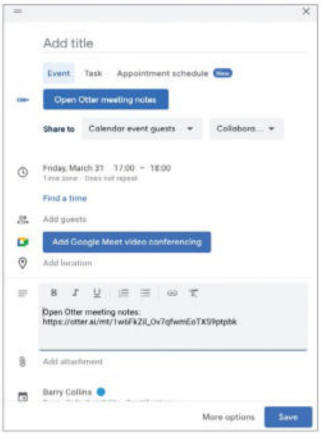
INSTALL THE BROWSER EXTENSION

Otter has a Chrome extension (which works in Edge and other Chromium-based browsers) that makes it dead simple to get full transcripts every time you have an online meeting. When the meeting starts, you'll be prompted to record the meeting in Otter, with a live transcript appearing in the browser alongside your Google or Zoom meeting. It's a visual reassurance that everything is being recorded.

SYNC YOUR CALENDAR

Another tip is to sync your calendar with the service. This means that when you create meetings in Google Calendar, you can press a button to have Otter sit in and take notes. A link to the meeting notes is then added to the calendar invite itself, so you can always dip back into your calendar and find the transcript or notes from the meeting.

You can share meeting notes with the other participants.


Add title
Event
Task
Appointment schedule
New
Open Otter meeting notes
Share to
Calendar event guests
Collabora...
Find a time
Add guests
Add Google Meet video conferencing
Add location
Add attachment
More options
Save

Friday, March 31 17:00 – 18:00

Open Otter meeting notes:
https://otter.ai/mt/1wbFkZiL_Ov7qfwmEoTXS9ptpbk

Barry Collins

You can tweak your Otter settings to have it automatically transcribe all of your video meetings, although there may be some meetings you don't want a record of.

VIEW THE AUTO-SUMMARY AND ACTION POINTS OF MEETINGS

Otter is not bad at creating automatic summaries of meetings. It seems to listen out for people posing questions, and uses those as summary headers of the meeting, allowing you to subsequently jump straight to the section of the transcript in question.

Otter also allows you to go back and pick out the action points from meetings, which can be assigned to attendees. Simply go back through the transcript and highlight any part of the meeting that consists of an action point. A pop-up menu will appear, from which you should choose the tick icon. From here, you can assign it to a particular attendee. Action points are then emailed to attendees to ensure they're aware.

SHARE MEETING NOTES

It can, of course, be enormously helpful for all attendees of a meeting to have the Otter transcript, not only the meeting organizer. If you've created the meeting in Google Calendar and pressed the button to add Otter meeting notes, you'll see a dropdown menu that allows you to share the notes with all attendees or other colleagues. That latter option could actually be more useful, as it allows you to bring absent colleagues up to speed on a meeting they've missed, without you having to give them a verbal or written update yourself, saving time and duplicated effort.

SEND OTTER TO MEETINGS ON YOUR BEHALF

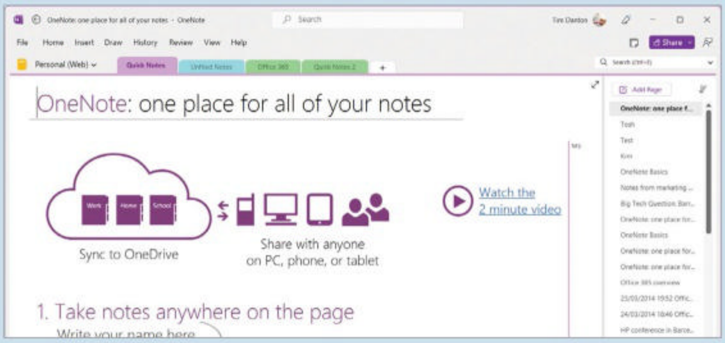
Calendar conflicts sometimes mean you can't be in a meeting, but it is possible to send Otter on your behalf. Join the meeting and switch Otter on, and you can then put yourself on mute, switch off your video and let Otter take notes. Of course, it won't participate, but you will be able to go back into Otter after the meeting has concluded and find out what you missed.

MICROSOFT OFFICE

EXPLOIT ONENOTE

John Johnson is one of many readers who relies on OneNote. "I can make or refer to notes, update to-do lists, or draft emails and documents from my phone or laptop," he says, and "action those when back at my desk, or vice versa." He also uses his "phone to dictate in OneNote, then pick up on PC."

OneNote lets you take or update notes from any device.


OneNote: one place for all of your notes - OneNote
Search
File
Home
Insert
Draw
History
Review
View
Help
Share
Personal (Web)
Quick Notes
Unfiled Notes
Office 365
Quick Notes 2
Add Page
Work
Home
School
Sync to OneDrive
Share with anyone
on PC, phone, or tablet
Watch the
2 minute video

OneNote: one place for all of your notes

1. Take notes anywhere on the page

Write your name here

PIN FILES AND FOLDERS IN THE SAVE DIALOG

In terms of time spent versus time gained, this must be one of the best tips around, and it applies to Word, Excel, and PowerPoint. In the same way that you can pin documents in Explorer and programs to the Taskbar, you can pin favorite documents to the Home and Open views in Office apps.

Open up PowerPoint (or Word, or Excel) and head to the Home dialog. Hover your mouse over the document you wish to pin, and Share and Pin icons will appear. Now, when you click on the Pinned option, your document will appear.

Pinning folders is a bit more convoluted. First, choose "Save As" for an open file, then browse to the folder you wish to pin, and right-click it. You'll see the option "Pin to Recent list" on the context-sensitive menu, so click it. The next time you head to the Open dialog, click on Folders (rather than Presentations) underneath the Search box, and your pinned folder will sit in the Pinned section at the top of the list.

© MICROSOFT, OTTER

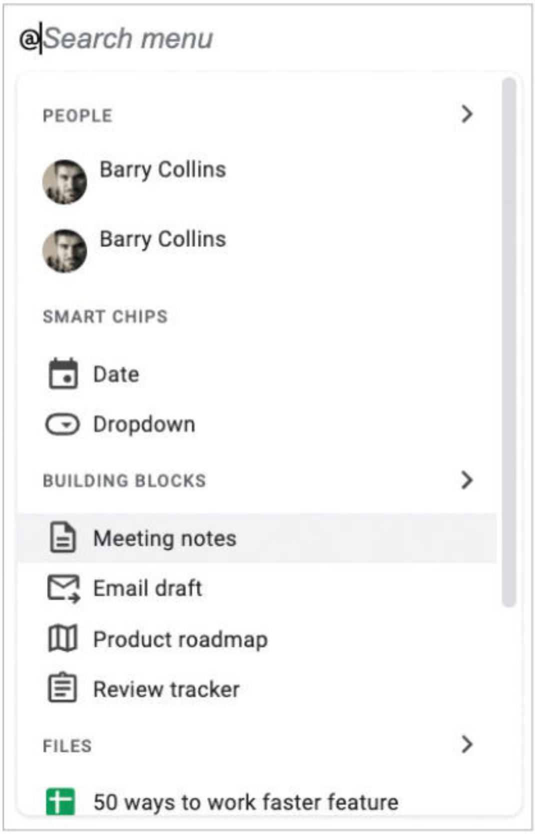
GOOGLE DOCS

AUTO-GENERATE SUMMARIES

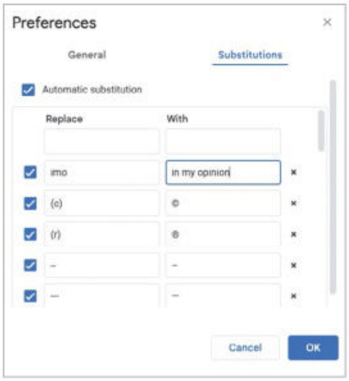
This is a feature that will soon become commonplace with the advance of AI tools, but if you've got a long report in Google Docs and need a quick summary, Docs can do this for you, provided you're a Workspace subscriber. To create an automatic summary, click View | Outline, and then click the little button next to the Summary field. In a few seconds, the AI should give you a heads-up of what the document is about. You can then copy and paste that text into the document itself.

USE SMART CHIPS

Smart Chips are a relatively new addition to Google Docs. You've probably stumbled across them by accident whenever you've typed the @ sign. When you do so, you'll be presented with a dropdown menu showing a series of items you can insert into your docs.


@Search menu
PEOPLE
Barry Collins
Barry Collins
SMART CHIPS
Date
Dropdown
BUILDING BLOCKS
Meeting notes
Email draft
Product roadmap
Review tracker
FILES
50 ways to work faster feature

Smart Chips let you get someone's attention fast.


Preferences
General
Substitutions
Cancel
OK

☑ Automatic substitution

	Replace	With
☑	imo	in my opinion
☑	(c)	©
☑	(r)	®
☑	–	–
☑	—	—

Save typing out long phrases by using Google Docs' substitutions.

If you're writing a business proposal and need colleagues to review a certain section, you can grab their attention by typing @ and then their name. If you're setting a deadline for something, you can type @ then the date—and that's smart enough to understand commands such as "next Thursday" or "two weeks" and insert the relevant date.

You can also use smart chips to insert things such as meeting notes or product roadmaps, which is useful for internal project management when you need to keep everything on track.

DISCUSS A DOC

Collaboration has always been one of the great strengths of Google Docs. However, that can also lead to edit skirmishes and people working at cross purposes.

If you need to talk to a colleague to sort out a document disagreement, Google Meet is now built into Google Docs. You can talk about the doc with the video window appearing in a sidebar to the right, allowing you to quickly sort out something that might otherwise descend into a long comments thread that takes ages to resolve.

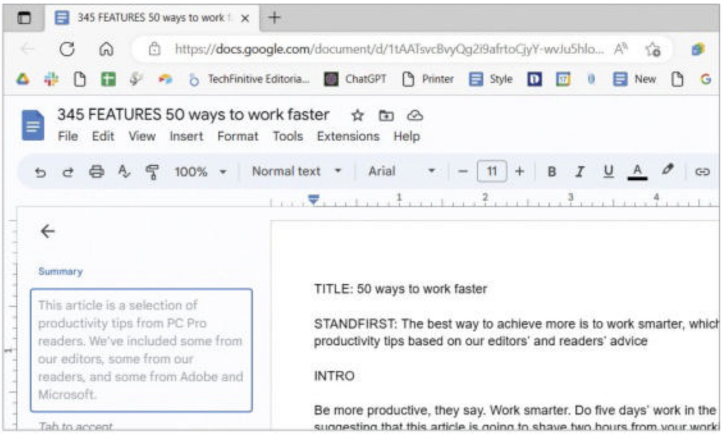
BRING ON THE SUBS

If you find yourself regularly typing the same long phrases over and again, you can use substitutions to save some of the fingerwork. This is basically Google Docs' equivalent of a text expander and you'll find it under Tools | Preferences | Substitutions.

So, for example, you could type "imo" and have it automatically replaced with "in my opinion". The annoying thing about Google's substitutions is that they ignore capitals and everything comes out in lower case. Hopefully, someone at Google Towers will read this and get it fixed.

CREATE A QUICK PDF

There's a neat piece of URL hackery you can perform to quickly share a Google Doc via PDF, without going through the rigmarole of File | Download | PDF, saving the file locally and attaching it to an email. Instead, remove the word "edit" from the end of the URL of the doc you're working on and replace it with "export?format=pdf" (without the quote marks), then copy that URL and send it to clients directly. However, be aware that the PDF is refreshed with the latest version of the document every time someone downloads it. If you want to send a PDF of a document in a fixed state, download and export using the method above to have Otter sit in and take notes. A link to the meeting notes is then added to the calendar invite itself.


345 FEATURES 50 ways to work f
https://docs.google.com/document/d/1tAATsvcBvyQg2i9afrtoCjyY-wvJu5hlo...
TechFinitive Editoria...
ChatGPT
Printer
Style
New
345 FEATURES 50 ways to work faster
File
Edit
View
Insert
Format
Tools
Extensions
Help
100%
Normal text
Arial
11
B
I
U
A
Summary
Tab to accept

This article is a selection of productivity tips from PC Pro readers. We've included some from our editors, some from our readers, and some from Adobe and Microsoft.

TITLE: 50 ways to work faster

STANDFIRST: The best way to achieve more is to work smarter, which productivity tips based on our editors' and readers' advice

INTRO

Be more productive, they say. Work smarter. Do five days' work in the suggesting that this article is going to shave two hours from your work

Google Docs can now automatically provide a summary of a long document.

© GOOGLE

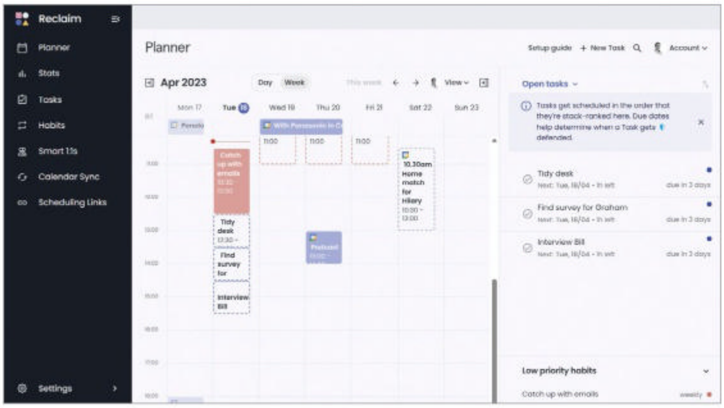
GENERATIVE AI

SHORTEN SEARCH TIMES

There's a reason Google's share value dropped 10 per cent when its AI demonstration went wrong: AI search is the future. What's more, Microsoft has already taken a clear lead with its integration of AI into Bing, while Bard remains in the pre-release stage. Let's say you're looking for cheap phones. A Google search will bring up a list of articles that cover the subject, but Bing's AI tool provides a shortlist of five candidates and provides nearby locations where you can buy them.

SKETCH OUT A BLOG POST

There are a huge number of AI-writing tools to play with, but our favorite so far is Writesonic. If you want to write a blog post then Writesonic can take you through the process step by step, providing suggestions along the way—even writing the whole thing for you from a couple of prompts. As ever, it's no substitute for an expert writer, but we think it's better than much of the waffle you see in blog posts elsewhere. Final note: you will need to check details, but thanks to GPT-4, it now adds references.



Tasks get scheduled in the order that they're stack-ranked here. Due dates help determine when a Task gets defended.

Reclaim can help organize your diary effectively.

AUTOMATICALLY SCHEDULE YOUR DIARY

There are numerous AI diary tools out there—and Microsoft is going to bring its own once Copilot arrives—but none will magically sort out your life. However, if you're willing to invest some time (and give it access to your Google Calendar and Slack), then Reclaim.ai is worth investigating. It's most effective when implemented across a team, but even if you're just using it for yourself you should find its automatic scheduling of meetings (and decompression times, lunch, and team catchups) will help—and maybe improve your focus, too.

SUMMARIZE CHUNKS OF TEXT

Just as Otter.ai can summarize meetings, AI tools can turn someone's rambling collection of paragraphs into a neatly formatted summary that's far easier to understand (or you can use it to improve your own writing before it's sent out). You don't even need to pay for these tools, as Bing AI, ChatGPT and Google Bard will all happily convert a few paragraphs of prose for you in a matter of seconds. And, based on our tests, these AI tools cut out the fluff rather than removing the important info.

LET AI DO YOUR RESEARCH

Let's say you want to find out all the training services on offer to doctors. In the past, that meant digging through Google, following links, and chasing numerous dead-ends. With AI such as ChatGPT, you ask the question and see what information it brings back. Some of it may be out of date or even wrong, but it will still save time.

FLESH OUT YOUR IDEAS

Why not let AI enhance your creativity with some extra ideas? For example, if you were writing an article about time-saving ideas, you could ask it for its suggestions.

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4 MORE QUICK TIME-SAVERS

VIM AND SHAREX

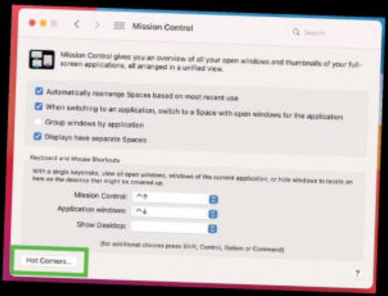
Gerald Tömpsett says: "I've used markup since the 90s and shareX to capture to cloud (imgur) and its OCR to import into Vim. Both are platform-agnostic so work equally well on Nix, macOS or Microsoft. I now use PowerShell along with AutoHotkey to convert between formats."

ENABLE FOREST

Forest is a cross-platform app (plus a Chrome extension in Windows) that allows you to create a "blocklist" of apps to stop you from becoming distracted. So, you set the timer, activate the blocklist, and it won't let you launch those apps until the timer ends or you override.

HOT CORNERS

This tip is for Mac owners only. The idea is to start an app (or action) by moving your pointer to one of the corners; by default, the bottom one is set to start Quick Note. You can set more hot corners by heading into System Settings and clicking "Desktop & Dock", then Hot Corners.



Mission Control gives you an overview of all your open windows and thumbnails of your full-screen applications, all arranged in a unified view.

☑ Automatically rearrange Spaces based on most recent use
☑ When switching to an application, switch to a Space with open windows for the application
☐ Group windows by application
☑ Displays have separate Spaces

With a single keystroke, view all open windows, windows of the current application, or hide windows to locate an item on the desktop that might be covered up.

Mission Control: ^↑
Application windows: ^↓
Show Desktop:

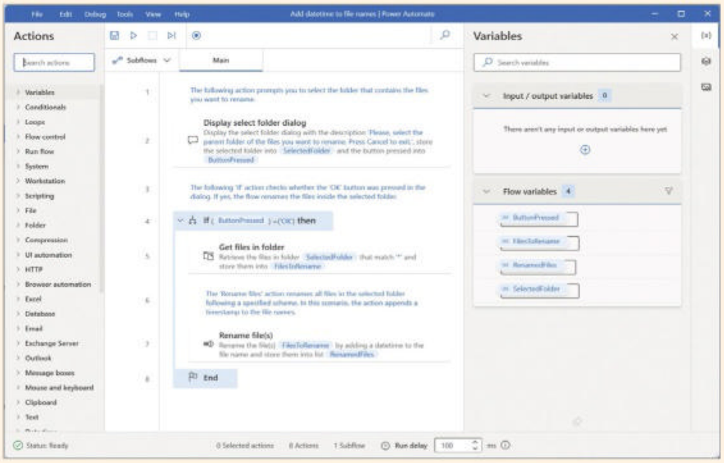
(for additional choices press Shift, Control, Option or Command)

Hot Corners let you start a macOS app with your mouse

AUTOMATE TASKS ON A MAC

Automator can help make repetitive tasks quicker. Apple provides a bunch of actions (such as creating a calendar event or ejecting a disc), and you can easily automate them.

MICROSOFT WINDOWS


File
Edit
Debug
Tools
View
Help
Add datetime to file names | Power Automate
Actions
Search actions
Variables
Conditionals
Loops
Flow control
Run flow
System
Workstation
Scripting
File
Folder
Compression
UI automation
HTTP
Browser automation
Excel
Database
Email
Exchange Server
Outlook
Message boxes
Mouse and keyboard
Clipboard
Text
Subflows
Main
Variables
Search variables
Input / output variables
Flow variables
ButtonPressed
FilesToRename
RenamedFiles
SelectedFolder

1 The following action prompts you to select the folder that contains the files you want to rename.

2 **Display select folder dialog**
Display the select folder dialog with the description 'Please, select the parent folder of the files you want to rename. Press Cancel to exit.', store the selected folder into SelectedFolder and the button pressed into ButtonPressed

3 The following 'If' action checks whether the 'OK' button was pressed in the dialog. If yes, the flow renames the files inside the selected folder.

4 If (ButtonPressed) = ('OK') then

5 **Get files in folder**
Retrieve the files in folder SelectedFolder that match '*' and store them into FilesToRename

6 The 'Rename files' action renames all files in the selected folder following a specified scheme. In this scenario, the action appends a timestamp to the file names.

7 **Rename file(s)**
Rename the file(s) FilesToRename by adding a datetime to the file name and store them into list RenamedFiles

8 End

There aren't any input or output variables here yet

Status: Ready · 0 Selected actions · 8 Actions · 1 Subflow · Run delay 100 ms

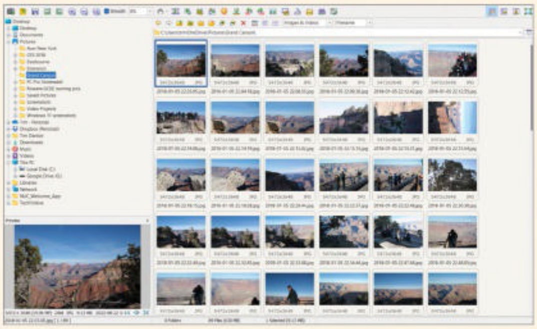
Power Automate is a powerful tool to automate tasks.

POWER UP YOUR SCREENSHOTS

"I now use the newer snipping tool (Windows+Shift+S)," wrote Si Mellor. "Once you draw your box on the screen, it copies this straight to the clipboard." But Robert Schifreen upped the stakes. "Greenshot (freeware) is better," he declared. "You can save the clipped image to a file directly, open it in an editor, copy to clipboard, etc. And it hooks into the PrtSc key rather than requiring you to press three keys." Martin Bailey added that he uses SnagIt for "screenshots on steroids", such as capturing a right-click menu via a delay timer, and uses ArsClip to "store multiple recent clipboard copies across all applications".

SUPERCHARGE FILES AND FOLDERS

While Mike Halsey describes himself as an "old-skool guy" who sorts "files, emails and documents into a strict folder structure so I can find them again easily", two of our readers had a different approach. "I do a lot of file manipulation," wrote John Wright. "Using bash (via git-bash) is a great way to find, filter and manipulate text files." (We recommend giving Everything a whirl, too.) Robert Neuschul relies on ExamDiff Pro (prestosoft.com) to compare files and directories within Windows.



Fastone Image Viewer is a big upgrade on the Windows version.

REPLACE THE WINDOWS IMAGE VIEWER

Who hasn't been annoyed by the slowness of the Windows image viewer? Or its lack of features. That's why Robert Neuschul switched to Fastone Image Viewer, even using it to "process Raw files as well as JPG/PNG".

WIN+X

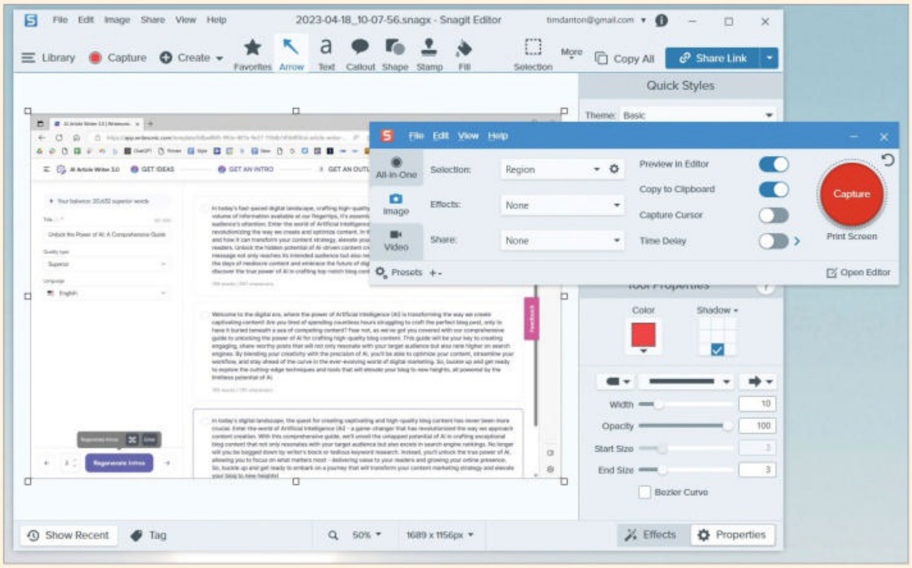
As Paul McCool pointed out to us, keyboard shortcuts "can take time to learn… but the time saved all adds up". We agree, and as a starter for ten may we suggest adding Win+X to your armory. This bypasses the usual graphical Windows interface so you can jump straight to, say, the Task Manager.

TOUCHPAD GESTURES

If touching a keyboard is simply too much effort, here are four of our favorite touchpad gestures on Windows. Swipe down with three fingers: all your active windows disappear to reveal the desktop beneath. Swipe up with three fingers: all your open windows spring into action. You can also switch between open applications by swiping left/right with three fingers, or upgrade to master level and add a fourth finger to switch between desktops.

LOAD UP POWER AUTOMATE

Power Automate isn't for beginners, but if you want to get your hands dirty in coding, you may find that it saves you an immense amount of time by automating workflows to the nth degree. It's built into Windows 11, but you may need to download the app from the Windows Store if you're running Windows 10.


File
Edit
Image
Share
View
Help
2023-04-18_10-07-56.snagx - SnagIt Editor
timdanton@gmail.com
Library
Capture
Create
Favorites
Arrow
Text
Callout
Shape
Stamp
Fill
Selection
More
Copy All
Share Link
Quick Styles
Theme: Basic
All-in-One
Image
Video
Capture
Print Screen
Presets
Open Editor
Tool Properties
Color
Shadow
Bezier Curve
Show Recent
Tag
Effects
Properties

Selection: Region

Effects: None

Share: None

Preview in Editor

Copy to Clipboard

Capture Cursor

Time Delay

Width 10

Opacity 100

Start Size 3

End Size 3

50% · 1689 x 1156px

SnagIt can produce "screenshots on steroids", according to one reader.

© MICROSOFT

CENTERFOLD

PERFORMANCE GEAR LAID BARE

Corsair Xeneon 27QHD240

OLED PANEL TECH is finally a thing on the PC desktop. Give it up for the Corsair Xeneon 27QHD240, the latest in a growing army of OLED gaming monitors. It uses LG WOLED technology, which comes with plenty of upsides, even if it thus far hasn't proven entirely optimal for the PC, mainly due to limited full-screen brightness. Corsair quotes 1,000 nits for peak brightness, which is mega. However, that figure is for a three percent window, and Corsair doesn't detail what the panel can sustain full screen.

Anyway, the main speeds and feeds besides brightness involve a 27-inch 1440p screen running at 240Hz. Factor in the outrageous pixel response of modern OLED screens, in this case rated at 0.03ms, and you have a recipe for sizzling speed. Moreover, the 1440p native resolution means you've got a chance of achieving zappy frame rates without the need to remortgage your house to pay for a monster GPU.

The problem, of course, is that the screen itself is super expensive at around $1,000. At that price, you can have all manner of 4K and monster-wide monitors, but not OLED monitors, and apart from the aforementioned speed, the big thing with OLED is the HDR performance. And you can keep your mini-LED backlights, because nothing compares to true per-pixel lighting control when it comes to HDR visuals.

It's well optioned out, too, with nice extras, including dual HDMI 2.1 ports and USB-C with power delivery to go with the default DisplayPort 1.4 interface. The build quality and design is super slick, too. This Corsair isn't cheap, then, and it isn't perfect, but it is awfully desirable. **–JEREMY LAIRD**

1 HDR AWESOMENESS

OLED technology is the real-per pixel deal. Each pixel is its own light source, meaning perfect lighting control. Imagine tiny pin pricks of light pumping out 1,000 nits of brightness right next to deep, inky blacks. That's what OLED can do, and it's what no LCD monitor, even the latest models with advanced mini-LED full-array backlights, can achieve.

2 SERIOUS SPEED

Corsair rates this panel at a sizzling 0.03ms for pixel response. That's getting on for two orders of magnitude better than any LCD monitor. Put simply, with OLED panel technology, the response problem is effectively solved. The near-instantaneous response of OLED tech is fast enough that any further improvements would be invisible to the human eye.

3 GET CONNECTED

OLED visuals aside, Corsair has specced the Xeneon 27QHD240 out with comprehensive connectivity. Along with the DisplayPort 1.4 socket, there are a pair of HDMI 2.1 ports, plus a USB-C interface, with power delivery for single-cable connectivity to a laptop PC. All four display interfaces support proper high-refresh gaming at 240Hz.

Microsoft is increasingly stuffing Windows 11 with cruft: tabloid news stories, AI assistants, needless apps. *Barry Collins* shows you how to streamline the operating system

WINDOWS 11 TAKE OUT THE TRASH

OPERATING SYSTEMS should just get out of the way. Increasingly, however, Windows 11 appears intent on getting in your face.

Perhaps emboldened by a decade of largely being left to its own devices by the competition authorities, Microsoft is increasingly testing consumers' patience by injecting more and more unwanted extras into Windows 11: widget sidebars full of tabloid news stories; apps appearing on the Start menu; AI services being shoved into the limelight.

It's a frustrating battle for control of your own hardware. Microsoft sees Windows 11 as its territory, but many consumers think otherwise. If you're among them, then read on, because we're going to show you how to get a grip on Windows 11, curb Microsoft's worst excesses, and run Windows as you'd like it. We'll even give you a couple of alternative OSes to consider if Microsoft has stretched your patience too far.

JUNK NEWS IN WIDGETS

THE MISSED opportunities that are Windows 11 Widgets continue to infuriate rather than illuminate. With Microsoft's glacially slow approach to offering Widget space to third parties, it continues to stuff screen real estate with content from news channels, meaning you will often find your Widgets panel stuffed with utter drivel that you never asked for.

There are two approaches to dealing with this: clean the Widgets feed manually, or dispense with them altogether. If you want to keep the Widgets, Microsoft offers a range of personalization options that should at least keep much of the garbage beneath the fold (you'll need to scroll down to see it). Start by opening the Widgets panel (Windows+W or click in the bottom-left corner of the screen), and press the + button. Then, add any Widgets that are of interest to you. Look for the "Find more Widgets" link in the bottom of the Add Widgets screen, which opens the Microsoft Store, and offers a smattering of third-party Widgets.

Once you've added some Widgets, click on your Profile icon in the top right of the Widgets pane, and at the foot of that screen, click the small Manage Interests link. This allows you to tell Microsoft which news and other content you're interested in reading, so if Windows 11 does need to fill space in the Widgets pane, it might at least be something you're vaguely interested in.

Go back to the Widgets pane, and drag and drop the most interesting Widgets towards the top of the screen. Like the old Windows 10 Start menu, this can start to look messy, so try to line up similarly sized Widgets alongside one another. You can change the size of Widgets by clicking on the three dots in the Widget's top-right corner, which is another way of devoting more screen space to the stuff you actually care about.

Still getting news you don't care about? Click on the three dots on the top of that Widget, and select "Hide stories from [source]". There are options to tell Microsoft you want more or fewer stories like this, to further tailor the feed.

Most Widgets provide the option to customize their content from that three-dots menu. On the Stocks Watchlist, for example, you can tell it which stocks/currencies you want to follow.

If all of this sounds like too much work, switch the Widgets off and never have to deal with the fallout from the latest episode of *The Kardashians* again. Right-click on an empty space in the Taskbar, and switch off Widgets. The Windows+W shortcut will still work if you ever feel the urge to check out old *Jersey Shore* news.

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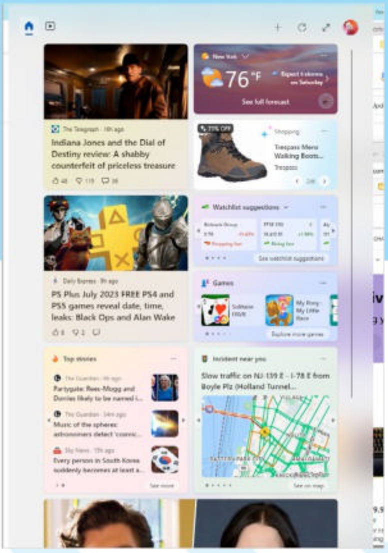
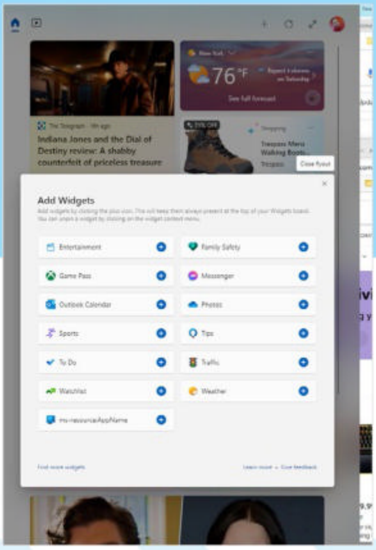
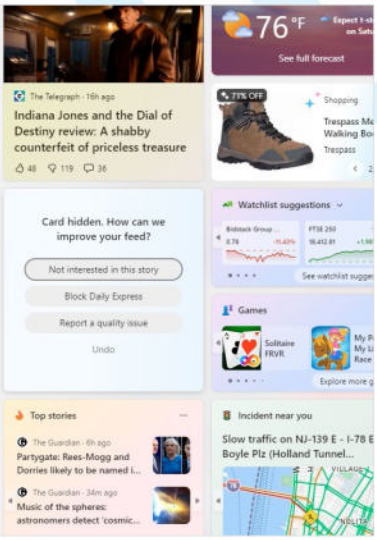

76 °F
See full forecast
The Telegraph · 16h ago
Indiana Jones and the Dial of Destiny review: A shabby counterfeit of priceless treasure
Shopping
Trespass Mens Walking Boots...
Watchlist suggestions
Games
Solitaire FRVR
Top stories
Incident near you
Slow traffic on NJ-139 E - I-78 E from Boyle Plz (Holland Tunnel...

You'll often find your Widgets panel stuffed with drivel like celebrity gossip.

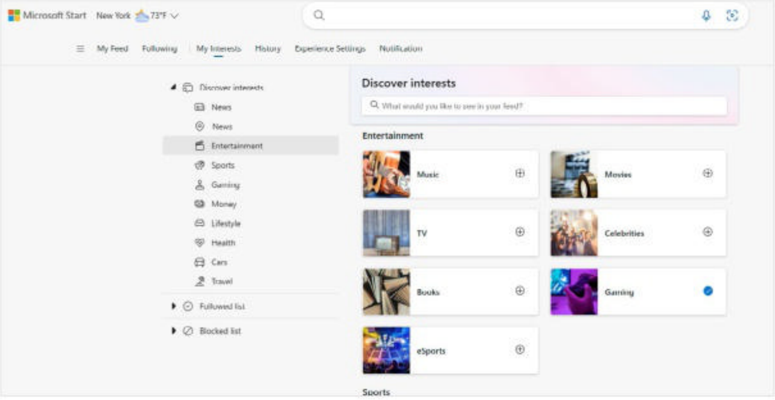

Close flyout
Add Widgets
Entertainment
Family Safety
Game Pass
Messenger
Outlook Calendar
Photos
Sports
Tips
To Do
Traffic
Watchlist
Weather
ms-resource:AppName
Find more widgets
Learn more · Give feedback

Add any Widgets that are of interest to you to drive down the rubbish that's not.


76 °F
See full forecast
The Telegraph · 16h ago
Indiana Jones and the Dial of Destiny review: A shabby counterfeit of priceless treasure
Shopping
Trespass Mens Walking Bo...
Card hidden. How can we improve your feed?
Not interested in this story
Block Daily Express
Report a quality issue
Undo
Watchlist suggestions
Games
Solitaire FRVR
Top stories
The Guardian · 6h ago
Partygate: Rees-Mogg and Dorries likely to be named i...
The Guardian · 34m ago
Music of the spheres: astronomers detect 'cosmic...
Incident near you
Slow traffic on NJ-139 E - I-78 E Boyle Plz (Holland Tunnel...

Tell Windows 11 you want more or fewer stories like this to customize your feed.

You can switch the Widgets off and never have to see the fallout from the latest episode of The Kardashians again


Microsoft Start
New York 73°F
My Feed
Following
My Interests
History
Experience Settings
Notification
Discover interests
News
News
Entertainment
Sports
Gaming
Money
Lifestyle
Health
Cars
Travel
Followed list
Blocked list
Discover interests
What would you like to see in your feed?
Entertainment
Music
Movies
TV
Celebrities
Books
Gaming
eSports
Sports

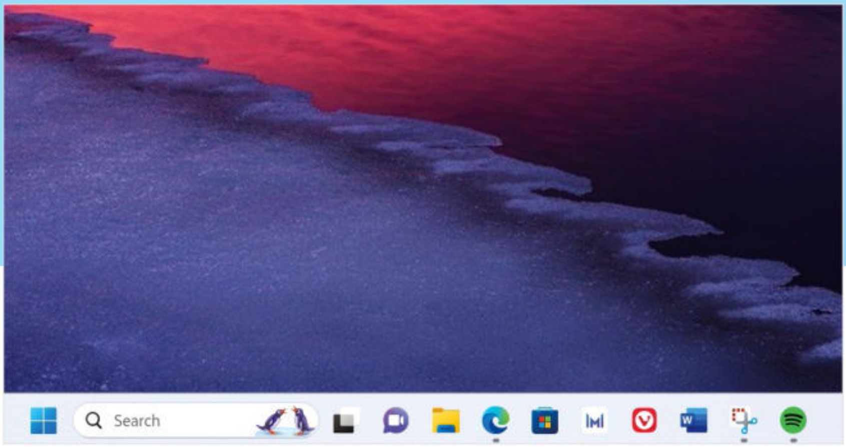
Block topics and sources from your feed if you're sure you don't want to see them.

THE FISHER-PRICE SEARCH BAR

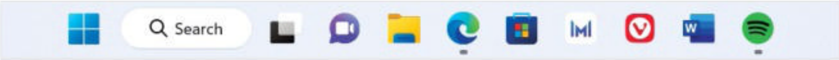
“YOU KNOW WHAT the Windows search bar really needs? A picture of a couple of penguins prancing around on the ice.” Said nobody. Ever.

The latest versions of Windows 11 have added graphics to the search bar in the Taskbar—a more pointless waste of pixels you’ll be hard-pressed to find, especially on laptops where you can easily run out of available space for app icons.

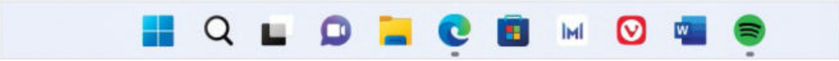
To obliterate this nonsense, right-click on any empty space in the Taskbar and select Taskbar Settings. Under search, choose “Search icon and label” or “Search icon only”, or even hide the menu altogether if you’re happy to press Windows+S when you want to search or use an alternative Windows search tool. PowerToys Run in Microsoft PowerToys (found in the Microsoft Store), which basically rips off Apple’s Spotlight search, is far preferable. See the section on replacing the Start menu opposite for another search alternative.



Do you really want some penguins dancing on your search bar?



You don’t have to put up with them...



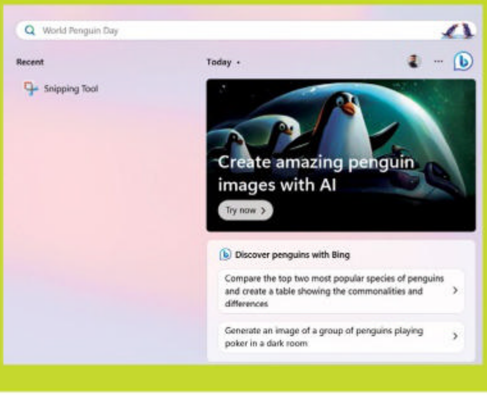
In fact, you don’t need to see the search bar at all.

STRIP THE “HIGHLIGHTS” FROM SEARCH

THOSE PICTURES aren’t just any random nonsense; they’re linked to the “highlights” you see in the search menu, where Microsoft tries to get you to do something equally pointless, like create AI pictures of penguins because it’s World Penguin Day.

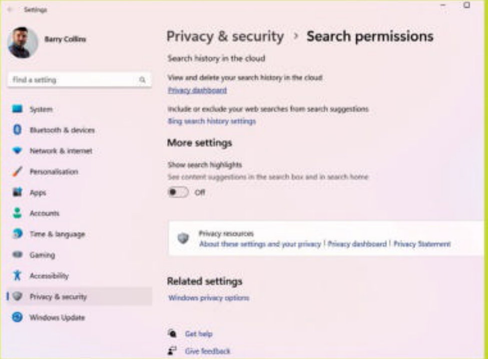
Now, we’ve got nothing against penguins. They’re perfectly acceptable birds. One of the better ones, even. But we much prefer them in zoos or ideally their natural habitat—not clogging up operating system search menus.

To drive this drivel underground, open the search menu (Windows+S), click the three dots next to your profile icon, and select “Search settings”. Drag down to “More settings”, and switch off search highlights. Unless your life is so empty that you hang on these daily distractions, that is...


World Penguin Day
Recent
Snipping Tool
Today
Create amazing penguin images with AI
Try now
Discover penguins with Bing

Compare the top two most popular species of penguins and create a table showing the commonalities and differences

Generate an image of a group of penguins playing poker in a dark room


Settings
Barry Collins
Find a setting
System
Bluetooth & devices
Network & internet
Personalisation
Apps
Accounts
Time & language
Gaming
Accessibility
Privacy & security
Windows Update
Get help
Give feedback

Privacy & security › Search permissions

Search history in the cloud

View and delete your search history in the cloud

Privacy dashboard

Include or exclude your web searches from search suggestions

Bing search history settings

More settings

Show search highlights

See content suggestions in the search box and in search home

Off

Privacy resources

About these settings and your privacy | Privacy dashboard | Privacy Statement

Related settings

Windows privacy options

FAR LEFT **Don’t fancy creating AI pictures of penguins for World Penguin Day?**

LEFT **Simply turn off the search highlights, and you won’t be bothered by them again.**

STRIP DOWN THE START MENU

WE'RE ALWAYS RELUCTANT to write about the Start menu here at *Maximum PC*, because by the time we've gone to print, Microsoft has usually altered the design at least eight times.

Ads—or Microsoft-promoted apps—have crept into the operating system in recent versions, and that now looks set to get even worse. A preview build of Windows 11 released in March is "continuing the exploration of badging on the Start menu with several new treatments for users logging in with local user accounts to highlight the benefits of signing in with a Microsoft account," according to a Microsoft blog post.

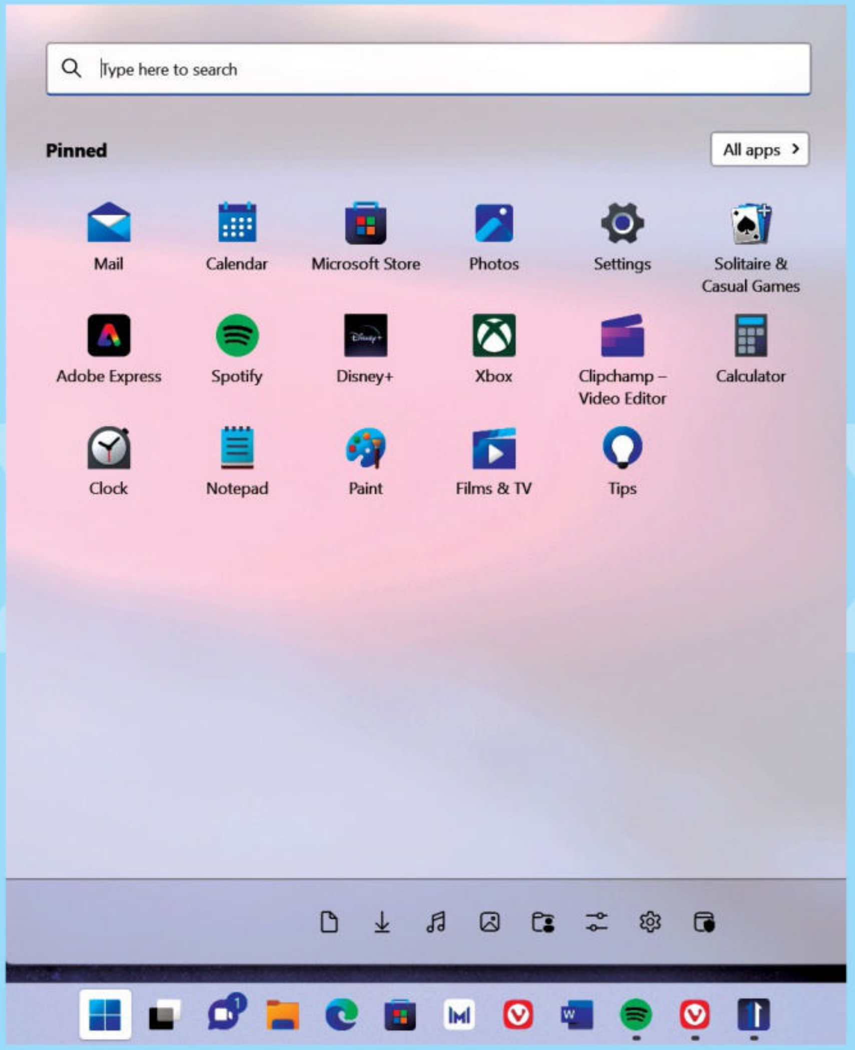
In other words, there will be more nagging to sign in with a Microsoft account if you've somehow crept past the badgering to do so when you first set up the machine or upgraded the OS. It's all very tiresome.

Seemingly, there's nothing you can do in Settings to stop Microsoft dropping random app icons into your Start menu or prevent the Microsoft account from nagging. The most effective way to get control back is to replace the Start menu entirely, although this does come at a cost.

We've recommended Stardock's Start11 in the past, mainly for those who didn't like the design of the Windows 11 Start menu, and wanted to go back to the Windows 10 (or even earlier) version. However, Start11 also does a decent job of delousing the Windows 11 design, letting you remove space-hogging irritations such as the Recommended Apps and allowing you to customize the Start menu to your own liking. The settings let you show recent documents on the Start menu, change the size of icons, force the Start menu to open with a full list of installed apps, among many others. The app also lets you tweak the Taskbar, aligning from the left and putting text labels back on open apps, and more.

Start11 can even replace the Search functionality with its own engine, which is much better than the default Windows search, in our opinion. For example, it lets you search the content of files, not just filenames (albeit at the expense of a little speed).

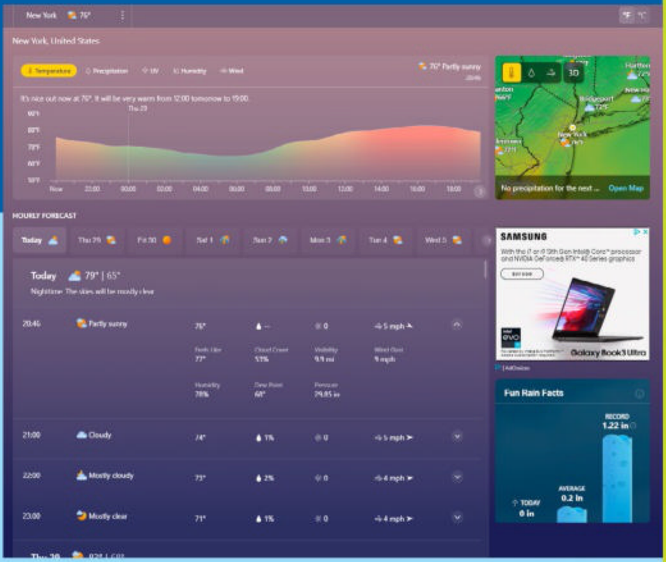
Stardock offers a 30-day trial of Start11, so you can find out if you get along with it before buying. After that, it's $5.99 for a single PC licence or $14.99 for a licence on up to five PCs. You'll find it at stardock.com.



Banish the fluff from the Windows Start menu with Start11.

The most effective way to get control back is to replace the Start menu entirely

© MICROSOFT



Ads have annoyingly even made it into your meteorological updates.

THE FORECAST IS SUN WITH A SPRINKLING OF ADS

AS IF IT HASN'T shoehorned in enough ads and promos in other parts of the operating system, a recent preview of the official Windows Weather app now shows ads appearing in that, too. Because who doesn't want to see a woman being reluctantly kissed while they're checking if it's going to rain on the way to work?

It doesn't appear there's anything you can do about that directly—there's no setting to remove the ads, just a link to Microsoft's advertising terms and conditions. So unless you've got something like a Pi-hole blocking ads at the network level, you're pretty much stuck with them if you want to get your weather from Microsoft.

A number of good websites provide weather forecasts without ads, so it's just another reason to avoid an app that's not exactly a must-have in the first place.

LEAVE THE TEAMS

HAVE YOU TRIED Microsoft Teams? Would you like Microsoft Teams? Hey you, what's that? Is it Microsoft Teams? Windows 11 often feels like it exists purely to shove Microsoft Teams under your nose more often than a handkerchief in flu season.

It comes pre-installed in Windows 11 these days, and not only pre-installed, but set to run at startup, and with the Chat icon crowbarred into your Taskbar for good measure. The new version of Teams is meant to be a lot less resource-hungry than its Electron-based predecessor, but if you don't use Teams, don't want Teams, and would quite happily live without ever hearing its name ever again, it's still an unwanted distraction.

If you want to be rid of it, it's a two-step process. First, right-click on a blank space on the Taskbar, click Taskbar Settings, and turn Chat off. Then, uninstall Teams in the normal way from the Apps section of the Settings menu.

Microsoft may try to sneak Teams back on to your machine when you get an Office software update (in case you happen to be based there, the company has just pre-emptively agreed to decouple Teams from Office in the EU, but this may not be applied in the UK). If you want to be sure that it won't come back with an Office update, you can add the preventteamsinstall value to the HKEY_LOCAL_MACHINE\SOFTWARE\Policies\Microsoft\Office\16.0\common\officeupdate key in the registry. The type for preventteamsinstall is REG_DWORD, and the value should be set to 1 if you don't want Teams installed.

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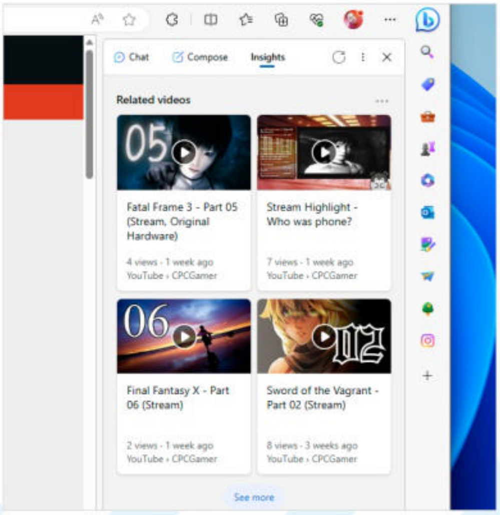
TRIM THE EDGE

These browser add-ons have an annoying habit of getting in the way of your browsing



You can get rid of the sidebar of shame in the settings.

EDGE HAS morphed somewhat since it emerged as "Chrome without the gubbins" several years ago. Microsoft has gradually added feature after feature to the browser, many of which fall into the "thanks, but no thanks" category, as far as we're concerned.

By default, there's now an entire right-hand sidebar devoted to some of these add-ons, including Shopping, Microsoft 365, and E-tree, the latter of which gives you virtual rewards for virtually watering a virtual tree. Do try to contain your excitement.

That's not to mention Microsoft's latest AI obsession, where it's trying to crowbar GPT-4-powered AI into everything you look at online. Some of those AI tools are very useful, such as the option to summarize long web pages into a few bullet points, but AI's not everyone's cup of tea, and these browser add-ons do have an annoying habit of getting in the way of your day-to-day browsing.

There are a few tidy-ups you can perform to make Edge more like that no-fuss browser that emerged all those years ago. First, you can get rid of that sidebar of shame. There's a little cog in the bottom right-hand corner of the Edge browser window. Click that and deselect the option that says Always show sidebar.

When you do that, you'll notice that the Bing speech bubble still lurks in the top-right of the screen, preparing to amaze you with its AI wizardry. If you want that gone, stay in the same settings menu as above (or search for "sidebar" in the browser settings if you've already closed it), and under "App and notification settings", select Discover. Turn off Show Discover, and you should have a much cleaner browser window to do with what you will. ⏻

Lightweight Windows alternatives

Looking for the antidote to Windows' ad stuffing? These might be worth a spin

Linux Mint

NO, 2023 is probably not going to be the year of Linux on the desktop, either. But if you're sick of using operating systems that see you as the product, Linux Mint is worth considering.

It comes in three flavors: Cinnamon is the best-looking and most fully featured; MATE Edition has the more classic-looking desktop from the noughties era; and the most lightweight of all is the Xfce Edition, which is designed to go easy on system resources and high on stability. It's still a 2.5GB download, mind, and it comes pre-installed with a large library of familiar Linux staples that will give you most of the apps you need for day-to-day computing: Firefox, Thunderbird, LibreOffice, and Rhythmbox are all on board. It ran perfectly happily from a USB stick on our Windows 11 laptop, and is refreshingly fuss-free.

ChromeOS Flex

A GOOGLE-SPONSORED operating system is hardly free of commercial grubbiness, but ChromeOS Flex is a less bothersome way to just get on with stuff in a web browser than Windows 11. In effect, it turns any laptop into a Chromebook, albeit one that doesn't have access to the Android apps that full-blown Chromebooks do. Still, if you're already embedded in the Google universe, those apps won't be a huge miss.

The one major downside of ChromeOS Flex is that it doesn't support dual booting. You can try it out by running the OS from the USB installer without actually installing it, but to benefit from maximum performance and automatic updates, you need to have it fully installed, which you can't do alongside Windows. Make sure you're ready to wave goodbye to your Windows installation and all associated data before you commit to the full install.

GET READY TO BECOME A TRUE PYTHON EXPERT

Make Python work for you with tutorials on coding with Django, Flask, Pygame and even more useful third-party frameworks.

NEW
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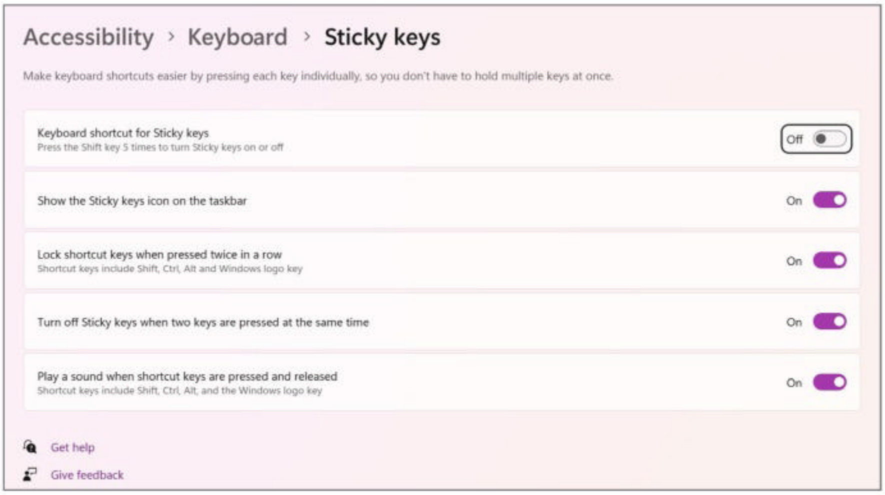
HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

TIP OF THE MONTH



Accessibility › Keyboard › Sticky keys

Make keyboard shortcuts easier by pressing each key individually, so you don't have to hold multiple keys at once.

Keyboard shortcut for Sticky keys — Off
Press the Shift key 5 times to turn Sticky keys on or off

Show the Sticky keys icon on the taskbar — On

Lock shortcut keys when pressed twice in a row — On
Shortcut keys include Shift, Ctrl, Alt and Windows logo key

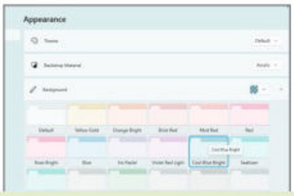
Turn off Sticky keys when two keys are pressed at the same time — On

Play a sound when shortcut keys are pressed and released — On
Shortcut keys include Shift, Ctrl, Alt, and the Windows logo key

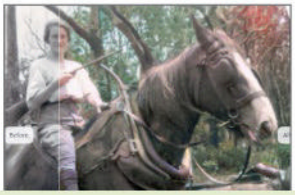
AVOID STICKY KEYS

Although it can be useful for people who are having issues typing with their keyboard, sticky keys can be annoying if accidentally activated. To avoid this, head into the Settings app > Accessibility > Keyboard, and find the sticky keys. Turn off the toggle switch for 'keyboard shortcut for Sticky Keys'. Now, you can spam your Shift, Control, or Alt keys as much as you please.

MAKE – USE – CREATE



62
Next-level Windows file management



66
Repair and colorize old photos

70
Replace passwords with passkeys

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SAM LEWIS
STAFF WRITER

GAMES OR MUSIC?

Last month, I was interested in picking up an ASUS ROG Ally, and I still am—I just haven't pulled the trigger yet. From upwards of $600 my heart says yes, but my brain is being more sensible. This is mainly because I'm lucky enough to get my hands on all sorts of gaming PCs and laptops on a monthly basis. That reduces those Ally cravings, but there is something about handheld gaming that makes it perfect for me. It's not often I get long stints of time to sit and play games—I know, boo hoo! It's more likely that a handheld system will suit my needs. I've got a PlayStation Vita, I just want to be able to play the triple-A titles I can on my desktop, but on the go. The Ally is one of the best options for this.

What I am more interested in is new headphones. Again, I'm very fortunate to test out quite a few of these, which on the flip side has made me very fussy. Recently, the SteelSeries Arctis Nova Pro impressed me with its comfort, punchy bass, and DAC, and if you're looking for something solely for PC use, they come highly recommended. The Sony WH-1000XM4s are more for portable use, but it's the current XM5s I have my eyes on. It begs the age-old question, games or music first? I'm leaning toward the latter, but time will tell.

↘ submit your How To project idea to: editor@maximumpc.com

Next-level Windows file management

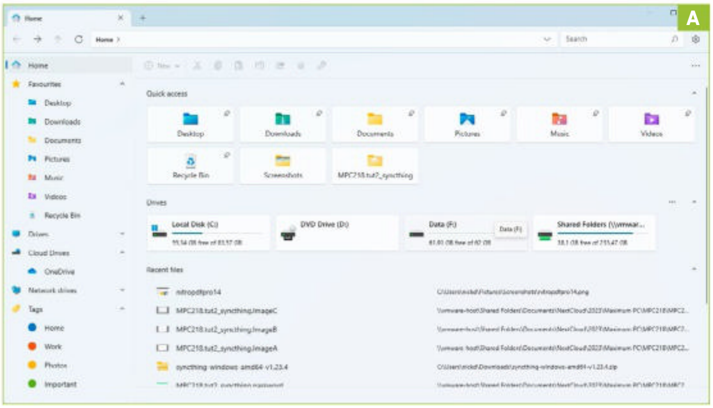
YOU'LL NEED THIS

TWO OPEN-SOURCE APPS, WHICH REQUIRE WINDOWS 10 OR LATER:
Files (https://files.community/) and Sigma File Manager (https://github.com/aleksey-hoffman/sigma-file-manager).

FILE EXPLORER HAS COME ON LEAPS AND BOUNDS in recent years—the recent introduction of tabs in Windows 11 is just one example—but despite its many improvements, File Explorer is still little more than a basic tool for navigating and managing your files and folders.

The good news is that you're not stuck with Windows' choice of file manager. There are plenty of alternatives, and we've sourced two great free and open-source examples. Both are designed to work alongside File Explorer, so you can try them without committing to a new way of doing things. Files aims to follow File Explorer in looks and feel, but still manages to offer plenty of good reasons to switch, from support for file and folder tagging to dual-pane navigation.

The other—Sigma File Manager—adopts a radically different look and approach, bundling a slightly different set of features (mostly notably support for 'workspaces', custom environments you can switch between as you see fit), but still manages to remain relatively straightforward to operate. In this tutorial, we'll introduce you to both so you can decide which one suits your file-management needs best. **–NICK PEERS**


A
Home
Search
Quick access
Desktop
Downloads
Documents
Pictures
Music
Videos
Recycle Bin
Screenshots
MPC218.tut2_syncthing
Drives
Local Disk (C:)
DVD Drive (D:)
Data (F:)
Shared Folders (\\vmwar...
Recent files
Favourites
Drives
Cloud Drives
OneDrive
Network drives
Tags
Home
Work
Photos
Important

1 TWEAK YOUR EXISTING EXPERIENCE

If you're broadly happy with how File Explorer looks and operates, head over to https://files.community/download to install Files—you'll find a link to the Microsoft Store, as well as a direct download to the "classic installer". Whichever option you choose, once in place, click Open or Launch.

» You'll see a familiar-looking two-column view with support for tabs, with the navigation panel on the left and the main view on the right. One subtle difference is that Files switches the position of navigation controls (placed directly beneath the tab) and file/folder buttons, which sit within the main column above the current folder or Home view, as shown in [**Image A**].

» Unlike File Explorer, Files's Home view combines both quick access, recent files, and drives within the same view. This view can be customized via the program's settings button (next to the Search bar), but more on that shortly. For now, let's focus on mastering basic navigation.

2 NAVIGATION MADE SIMPLE

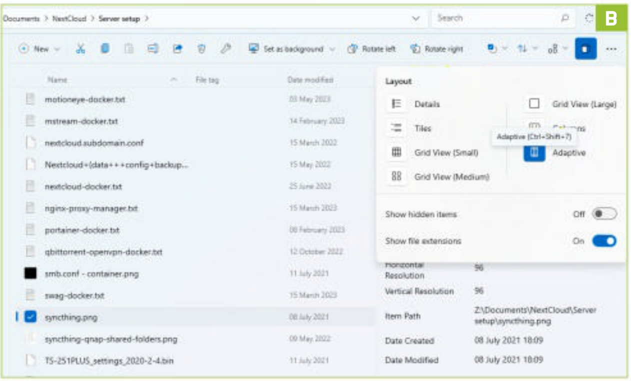
One difference you'll notice is that drives and folders require a single click to open. If you don't like this, open Settings and navigate to 'Folders > Behaviors > Opening items' to change both it and the default double-click behavior for files.

» When you select a file, you'll see the icons on the toolbar light up, just as they do in File Explorer. You'll also see context-sensitive items appear depending on the file type, such as rotating images clockwise or counterclockwise. Again, Files diverges from File Explorer by organizing these options differently, with selection, sorting, and layout options placed on the right [**Image B**], along with a button to quickly toggle the twin-tabbed (Details and Preview) preview pane on and off.

» The navigation panel on the left broadly follows File Explorer's example, but again offers several advantages over its counterpart. In addition to the Home widget's more useful display, Cloud Drives displays shortcuts to most installed third-party cloud providers—including Google Drive, Dropbox, and Nextcloud—in addition to OneDrive. But it's the widget at the bottom of the navigation pane that reveals one of Files's key selling points: Tags.

3 TAG YOUR FILES

Tags provide you with another way to label files to make them easier to find. Expand the Tags widget, and you'll see four are set up by default: Home, Work, Photos, and Important. You can apply multiple tags to files and folders, either via the right-click menu, or by dragging a file, folder, or group on to the tag in the Navigation pane. Repeat the process for as many tags as you wish to use.


B
Documents > NextCloud > Server setup
Search
New
Set as background
Rotate left
Rotate right
Name
File tag
Date modified
motioneye-docker.txt
mstream-docker.txt
nextcloud.subdomain.conf
Nextcloud+(data+++config+backup...
nextcloud-docker.txt
nginx-proxy-manager.txt
portainer-docker.txt
qbittorrent-openvpn-docker.txt
smb.conf - container.png
swag-docker.txt
syncthing.png
syncthing-qnap-shared-folders.png
TS-251PLUS_settings_2020-2-4.bin
Layout
Details
Tiles
Grid View (Small)
Grid View (Medium)
Grid View (Large)
Adaptive
Adaptive (Ctrl+Shift+7)
Show hidden items
Off
Show file extensions
On
Horizontal Resolution
96
Vertical Resolution
96
Item Path
Z:\Documents\NextCloud\Server setup\syncthing.png
Date Created
08 July 2021 18:09
Date Modified
08 July 2021 18:09

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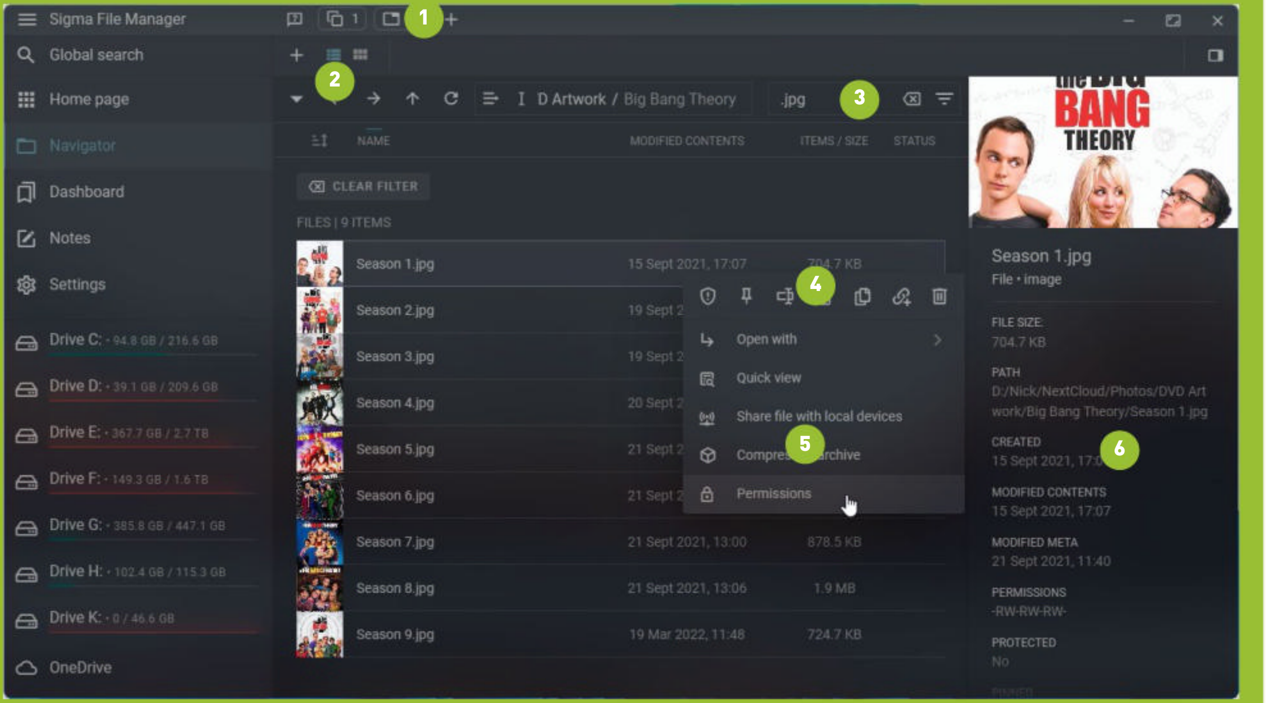
NAVIGATE WITH SIGMA FILE MANAGER


Sigma File Manager
Global search
Home page
Navigator
Dashboard
Notes
Settings
Drive C: · 94.8 GB / 216.6 GB
Drive D: · 39.1 GB / 209.6 GB
Drive E: · 367.7 GB / 2.7 TB
Drive F: · 149.3 GB / 1.6 TB
Drive G: · 385.8 GB / 447.1 GB
Drive H: · 102.4 GB / 115.3 GB
Drive K: · 0 / 46.6 GB
OneDrive
D Artwork / Big Bang Theory
.jpg
NAME
MODIFIED CONTENTS
ITEMS / SIZE
STATUS
CLEAR FILTER
FILES | 9 ITEMS
Season 1.jpg
Season 2.jpg
Season 3.jpg
Season 4.jpg
Season 5.jpg
Season 6.jpg
Season 7.jpg
Season 8.jpg
Season 9.jpg
Open with
Quick view
Share file with local devices
Compress to archive
Permissions
Season 1.jpg
File • image
FILE SIZE
704.7 KB
PATH
D:/Nick/NextCloud/Photos/DVD Art work/Big Bang Theory/Season 1.jpg
CREATED
15 Sept 2021, 17:07
MODIFIED CONTENTS
15 Sept 2021, 17:07
MODIFIED META
21 Sept 2021, 11:40
PERMISSIONS
-RW-RW-RW-
PROTECTED
No
1
2
3
4
5
6

1. SWITCH WORKSPACES AND TABS
Use these buttons in order to set up, manage, and switch between workspaces, as well as the currently selected workspace's tabs.

2. VIEW AND NAVIGATION
Here, you can switch between list and grid layouts, plus navigate through previous directories quickly and open the context menu for the current folder without having to go back one level to select it.

3. FILTER
Click here to generate filters based on filename or filetype, size, directory item count, and modified date. You can also toggle hidden files and folders.

4. CONTEXT MENU (ICONS)
Two options stand out from the row of icons at the top of Sigma's context menu: Protect prevents Sigma from being able to modify or delete the item, while Pin affixes the file or folder to the Dashboard for easy access.

5. MORE RIGHT-CLICK OPTIONS
The rest of Sigma's context-menu options contain some interesting app-specific options: 'Open with' lets you build your own library of apps to use, while 'Quick View' lets you preview files using Sigma's own file viewer.

6. DETAILS VIEW
Get information about the current folder or selected item here—a 'Get size' button allows you to manually calculate the size of a selected folder and its contents.

» Once applied, you can see what tags have been applied to a file or folder one of two ways: via the Tags column in Details view, or as a colored dot next to the filename when in Tiles or Grid view. Only one dot is displayed regardless of how many tags you apply; the color remains that of the first tag you applied. Tags are stored within the file themselves, meaning the files can be moved without losing the tag association, and can also be accessed using other apps that use the same system as Files.

» Once you've applied tags to files, clicking a tag under Tags in the Navigation pane will display a details list of all the files with the tag attached. You can also include tags in searches—simply use the 'tag:' prefix, such as 'tag: Photos' or 'tag: Documents, Important' for multiple tags.

» To manage your tags, click the Settings button and navigate to Tags. You can create new tags, plus edit (and delete) existing ones. When applying a tag color, you'll see that Files supports the entire color spectrum with multiple ways of selecting the perfect color, as shown in [**Image C**].

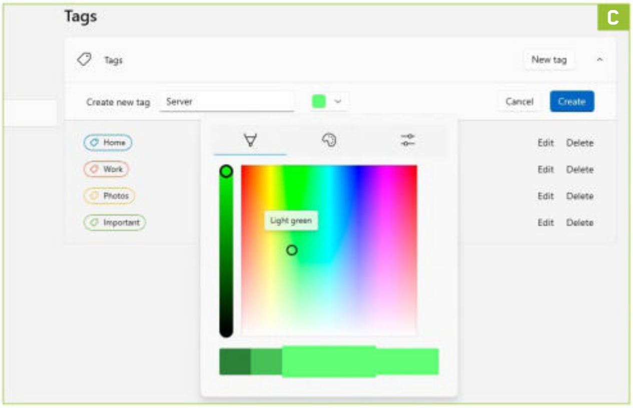
» Delete a tag, and it's removed from any files it's been applied to; the files themselves are otherwise left untouched.

4 DUAL-PANE NAVIGATION

The other big selling point of Files is the option to split its navigation pane in two. This allows you to place source and destination side by side without cluttering up your desktop with multiple file manager windows. To set up this split-screen view, click the ... button next to the 'Toggle the preview pane' button and choose 'New pane'.

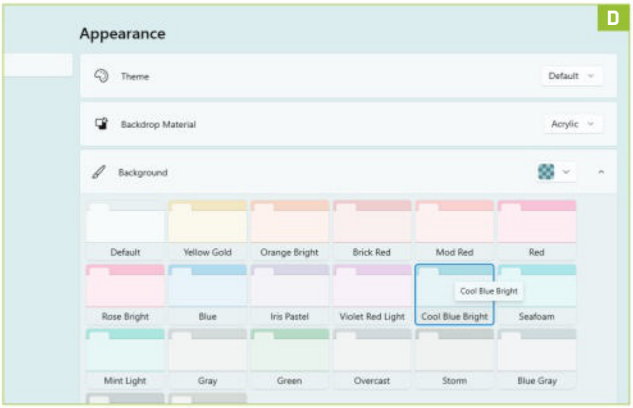
» The pane will split equally in two, with the new right-hand column pointing to your Home page. Use the divider to resize the panes as required, then navigate each pane independently of each other before dragging and dropping between them as required. The usual defaults apply—files copy across drives or move between folders on the same drive unless you hold down Shift or Ctrl, before dragging the files across to force them to move or copy respectively.

» In order to remove the right-hand pane and revert to a single view, click the ... button again and choose 'Close pane'.


C

Tags

Create new tag: Server


D

Appearance

Theme: Default

Backdrop Material: Acrylic

5 CUSTOMIZE FILES FURTHER

We've already touched on how you can tailor Files via its Settings button, but it's worth highlighting some of the additional tweaks it offers that further differentiate it from File Explorer. Start with the General tab and 'Startup settings'. Unlike File Explorer, which will always default to one of two places (This PC or Home), Files offers two additional options when you open it. The first allows you to pick up where you left off by restoring your previous window (including any opened tabs, split panes, and so on), while the second allows you to 'Open a specific page or pages'. When selected, click the ˅ button to reveal the options you need to add these 'pages', which are basically drives, folders, or files (like compressed zip files) that can be opened to show their contents. Each page then opens in its own tab.

» The General tab also gives you control over what widgets are shown on the Home page. Quick Access, Drives, and Recent Files are checked by default, but you'll also see options for Bundles and Tags. Ignore Bundles—it has been superseded by Tags, and will be retired in a future program update.

6 A FRESH NEW LOOK

Switch to the Appearance tab and you can change Files's color scheme and its 'backdrop material', as shown in [**Image D**]. The latter basically allows you to switch the default solid background (Mica Alt) to a semi-translucent (Acrylic) alternative. You can also compact the spacing between items in Details view to increase the number shown from here.

» The Folders tab concerns itself primarily with customizing how items are displayed in the folder pane, from selecting a default layout (Adaptive by default) to calculating folder sizes (which are then displayed in the Size column in Details view). You can also tweak behaviors such as automatically selecting folders and files simply by hovering the mouse over them or allowing you to double-click blank space to move back up one folder level.

7 EXPLORE SIGMA FILE MANAGER

If you're looking for a more radical revamp of File Explorer, then Sigma File Manager (https://github.com/aleksey-hoffman/sigma-file-manager) is worth trying out. Its look and feel deviates more from File Explorer than Files does, but it doesn't take too long to understand how it works, and in return you'll gain access to even more features, including a smart global search tool, built-in compression utility that supports most popular formats, and the ability to bypass your shared folders and distribute files wirelessly to any device on your local network.

» Like Files, Sigma is free and open source, and you can install it through the Microsoft Store or its own standalone installer—click 'Releases' on the main Github page to access the relevant links. Whichever method you choose, once installed, launch the program. Sigma opens to its Home page, one of five distinct sections (the others are Global Search, Navigator, Dashboard, and Notes). Switch between them using the icons in the top-left corner of the program window—click the hamburger icon (≡) above these to reveal the slide-out menu in all its glory.

» The Home page contains convenient shortcuts to user folders and drives, and is accompanied by a fetching media banner. Sadly, only the banner is currently customizable—control its appearance using the button to the right of the 'Home page' title. This reveals options for hiding the banner completely, selecting another image, and tweaking the image's position within the banner. There's also an option to change the banner's overall height—if you like the look, but feel that it dominates the Home page, try setting its height to the minimum (38vh), as shown in [**Image E**].

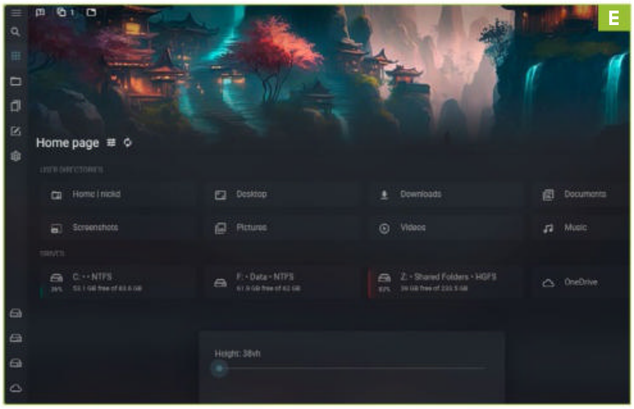
REPLACE FILE EXPLORER

The beauty of both Files and Sigma File Manager is that while they're designed to replace File Explorer, they sit quietly alongside it, giving you time to try both before deciding if either is a suitable replacement. You might decide that they're good for specific scenarios, but prefer File Explorer for day-to-day use.

If you'd like to pivot to either app, you could simply pin your app of choice's shortcut on the taskbar and unpin File Explorer as a halfway house. However, if you'd like to replace File Explorer with Files, you can go further and make it the default file manager. Simply navigate to Settings > Advanced, where you'll find the on/off toggle. Once set, pressing Win + E will open Files and it'll be evoked in place of File Explorer by any app that makes use of the file manager. On the downside, it comes with a warning that changes are made to the Registry that may result in unexpected side-effects.

The switch appeared to work fine in our tests—both for making Files the default and then reverting back to File Explorer, but if you're at all worried about making such a big change, take a System Restore point or update your system backup before proceeding.

© MICROSOFT



8 NAVIGATION AND WIRELESS FILE TRANSFERS

The Navigator is where you'll spend most of your time with Sigma—access it by double-clicking one of the shortcuts on the Home page or by simply clicking Navigator in the left-hand pane. This opens a simple two-paned view, with the contents of the currently selected directory on the left, and a details pane on the right, which either lists details of the current directory or any item you select in the left-hand pane—see the annotation for details.

» If you'd like to transfer a file or folder over your network without having to use a shared folder, right-click it and choose 'Share file/directory with local devices'. After clicking OK and granting Sigma access to your network if prompted, you'll see the Local share manager pop up as shown in [**Image F**]. Folders are shared via an 'ftp' folder, while files can be downloaded or streamed. The latter only applies to video, all other file types like images or PDFs will either be opened directly in your browser or trigger a download to that computer.

» Once you've made a note of the URL (or scanned it on your phone using the QR code), you can close the window. A 'Local file share is active' pop-up will remain, allowing you to copy the address again or cease sharing it by clicking 'Stop Server'. Be warned: while we had no problems sharing individual files, attempting to share a folder resulted in errors.

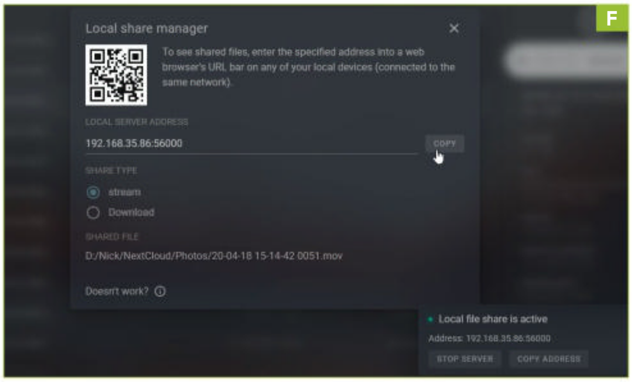
9 COMPLETE YOUR TOUR

Select Dashboard, and you'll see that it offers three views: Pinned and Protected refer to the context-menu items we've just discussed, while Timeline provides handy shortcuts to folders you've previously opened in Navigator view—double-click one to jump back to it in Navigator. The final section—Notes—is a place to store rich-text notes on any subject you like.

» Another of Sigma's selling points is its support for multiple workspaces—at the simplest level, each workspace can be seen as a set of uniquely configured tabs pointing to different directories and drives, but that merely scratches the surface, because workspaces can also include specific actions you can choose to run on demand: open programs, view websites and access files, plus run commands and scripts from the command line.

» The box reveals how to set up your first workspace. Once it's in place, click the workspace button at the top of the Sigma window, and your new workspace will be listed. Click this, and it'll immediately switch to that workspace's default directory, plus display a pop-up box containing a list of any associated actions. By default, these are only actioned if you click the relevant Run button (or click 'Run all actions' to run them simultaneously).

» Each workspace can also contain up to nine tabs, each one pointing to a different folder on your system. To create a new tab, first navigate to the directory you want it to point at, then click the + button to the right of the Workspace tabs button at the top of the Sigma window to create it. To add more tabs, make sure you've browsed to the folder before clicking + again. Tabs can be rearranged by drag and drop or via the Workspaces tab button. When you close Sigma or switch workspace, the tabs are saved in their current state, allowing you to pick up where you left off later. ⏻



To see shared files, enter the specified address into a web browser's URL bar on any of your local devices (connected to the same network).

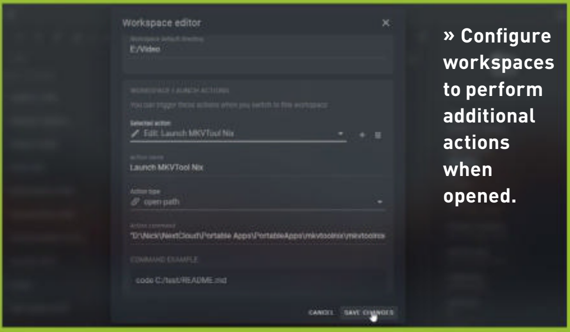
LOCAL SERVER ADDRESS
192.168.35.86:56000

SHARE TYPE
● stream
○ Download

SHARED FILE
D:/Nick/NextCloud/Photos/20-04-18 15-14-42 0051.mov

Local file share is active
Address: 192.168.35.86:56000

WORKSPACE MANAGEMENT



E:/Video

Selected action
Edit: Launch MKVTool Nix

Launch MKVTool Nix

Action type
open path

COMMAND EXAMPLE
code C:/test/README.md

» Configure workspaces to perform additional actions when opened.

To create a workspace, click the Workspaces button, followed by the edit (pencil) button. Click + to add a new workspace. Name it and type the full path to the directory you want this to point Navigator to—for example, E:/Photos.

Now, click 'Add New Action' beneath this to create your first action. After giving it another suitably descriptive name, choose your action type (three are supported: open-url opens a web address in your browser, while open-path lets you open a specific file or application—in the case of the latter, simply enter the full path to the app. The final option—'terminal-command'—can be used to invoke any command supported by the Run (Win + R) box, as well as Powershell, command prompt or Terminal commands, or scripts (select which one to use via Settings > Advanced).

Once you've completed your first action, click + next to 'Add: New action' to add another, or 'Create workspace' to finish setting up the workspace. You can edit the workspace from the same dialog, where existing workspaces and actions can be selected via dropdown menus.

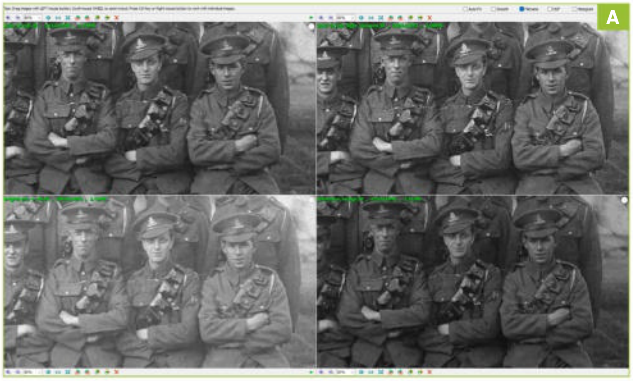
Repair and colorize old photos

YOU'LL NEED THIS

SCANNER, SOME OLD FAMILY PHOTOS
Also recommended: VueScan scanning software, Paint.NET, Photoshop Express, and VanceAI PC app

IF YOU'RE FORTUNATE ENOUGH to possess a trove of old family photos, then you'll know that they rarely come down to you in the best possible condition. In addition to dust, scratches, and other blemishes, photos fade over time, becoming washed out and losing color. In an age where you didn't have the luxury of instant review and unlimited second chances, many photos may be less than perfect—if not blurred or badly framed, then suffering from poor exposure.

If you have an Adobe Creative Cloud subscription, dig out your copy of the January 2023 issue and follow Ian Evenden's excellent tutorial on tapping into Photoshop's increasingly powerful photo restoration capabilities. But Photoshop isn't the only tool out there you can tap into to breathe new life into old photos. In this tutorial, we'll show you how to improve the quality of your initial scans to bring out as much original detail as possible, then we'll reveal a range of tools to improve them further, from removing blemishes to correcting lighting and color problems. We'll even reveal how to inject realistic color into old black and white photos, giving you a more vivid window into your family's past. **–NICK PEERS**



1 MAXIMIZE SCAN QUALITY

If you have access to the original photo, then step one is to secure as high a quality of digital scan as possible. While you can capture photos on the go using your phone and the free Google PhotoScan app (www.google.com/photos/scan/), the best tool for the job is your flatbed scanner. Taking a fresh scan of your photo also gives you the opportunity to mitigate problems, potentially teasing out details that might otherwise be lost.

» The obvious tool for the job here is your scanner's own built-in utility or—failing that—the WIA scan utility built into Windows, but these can be somewhat lacking in even basic controls.

» At the very least, your scanning tool should allow you to choose whether the photo is grayscale or color, and allow you to choose your scan resolution in dots per inch (DPI). As a rule of thumb, always scan at a minimum of 300 dpi, which means your digital copy is the same physical size as the original. In theory, you can double (600 dpi) or even quadruple (1200 dpi) the size of your photo during the scanning stage, but don't expect miracles, particularly with smaller photos. It's better to scan passport-sized snaps at 300 dpi, then use AI to try and double their size.

» A decent scanning utility should also allow you to manually select the area to scan and view a preview of the scan area so you can line up your photo correctly and get some idea of how any adjustments affect the final image. If your scanner's own software doesn't supply these basic tools, we recommend investing in the best photo scanning tool out there: VueScan.

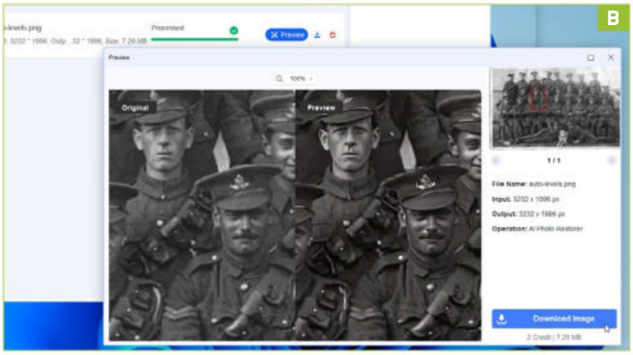
2 SCAN REFERENCE IMAGE

Download the trial version of VueScan from www.hamrick.com. Once installed, it should detect your scanner and let you try out most of its major functions, the only limitation being a non-removable watermark that's added to your photos. This lets you verify that the program is right for you before you purchase. Three tiers are available—we recommend Standard ($49.95) or Professional ($99.95) for maximum flexibility.

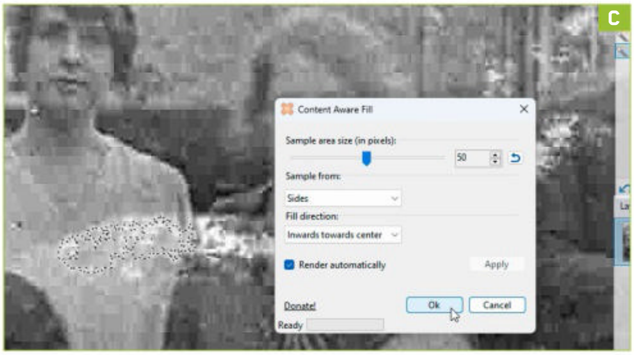
» Launch VueScan. On the Input screen, make sure Standard is selected under Options, then set Media to Color or Gray, depending on your original photo. Below this, set the 'Preview resolution' and 'Scan resolution' to 300, 600, or 1200 DPI, depending on the resolution you plan to scan your photo in. Click Preview, then use the crop tool to select your photo before switching to the 'Cropped area' tab to view it up close.

» Let's start by creating a 'reference' image—a version of the photo without any filters or lighting adjustments. Use the options at the bottom of the Input tab to choose where to save the scanned photo, its file type (choose TIFF for best quality), and provide a filename. Once done, click Scan.

» Once complete, open the folder and double-click the photo, which should open it in the Photos app or your default image editor. Take the time to examine it—zoom in up close to see how much detail is present. Make a



File Name: auto-levels.png
Input: 3232 x 1096 px
Output: 3232 x 1096 px
Operation: AI Photo Restorer



Sample area size (in pixels): 50

Sample from: Sides

Fill direction: Inwards towards center

☑ Render automatically

note of any imperfections: faded colors, poor lighting, evidence of dust and other small blemishes—let's see if we can correct some of these in VueScan.

3 CREATE MORE SCANS

Return to VueScan and switch to the Filter tab to experiment with some simple filters. Ignore both 'Restore colors' and 'Restore fading'—the latter applies to slides and negatives only, while the former is a blunt instrument, and you can exhibit finer control via the Colors tab shortly. One filter worth testing is Sharpen—click its dropdown menu to reveal Light, Medium, and Heavy options. In most cases, don't push things beyond Light, or you'll create unwanted artefacts like visible halos or dark lines. The preview window will give you an idea of what effect these changes will have.

» Next, visit the Color tab, where you can restore some vibrancy to faded color photos, plus attempt to improve overall lighting levels, regardless of whether the photo is color or black and white. Use the Color balance dropdown menu to try some quick and easy presets, including an 'Auto levels' option. Alternatively, select Manual and experiment with the Black point, White point, and Brightness to correct under- or over-exposed images, or at least tease out a little more detail from the photo itself.

» The Professional edition (choose 'Professional' on the Input tab's Options dropdown) reveals even more options for advanced users to play with, such as a Grain Reduction option under Filters, and Curve points under Color. Whether you try these or not, experiment with different settings, creating new scans each time, then give them suitably descriptive filenames when you save.

» To compare scans side-by-side, install FastStone Image Viewer (www.faststone.org). Open the program, navigate to the folder containing your scans, select two or more, and press 'p' to open the Compare Images dialog, as shown in [**Image A**]. Zoom in to examine it up close to determine which scan looks best. Click Close, select this version, and choose File > Save as... to save a copy in PNG format to make it universally accessible to other apps and services.

4 TAP INTO AI

Once you've got a scan of your photo that you're happy with, it's time to see how you can improve it. Open your web browser, and search for AI photo repair tools to discover a mind-boggling array of choices.

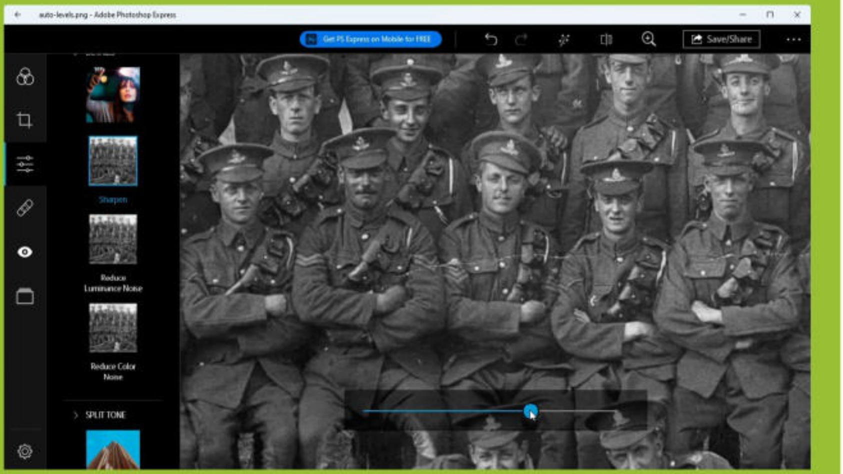
» Some offer free services, or will process a limited number of images for free. One example is VanceAI (vanceai.com/old-photo-restoration), which offers a PC app to process your photos through. This works in one of two ways: you can use your PC's processing power up to five times for free before having to purchase a license, or you can sign up for a free account and get 10 credits to use to test the service out. Going forward, the credit subscription model ($4.99 a month for 100 credits) is a lot cheaper than the PC version ($39.90 a month or $129.90 for a lifetime license).

» The app offers several tools, two of which stand out. Enlarge does a great job of doubling the size of photos using AI to fill in the missing blanks—just select your photo, choose your settings, and click 'Start to Process'.

QUICK-FIRE PHOTOSHOP FIXES FOR FREE

If you're looking for a quick way to tweak old photos, install Adobe Photoshop Express for free through the Microsoft Store. Once installed, open the app to sign up (or sign in with an existing Adobe ID) to gain access to its simple fixes.

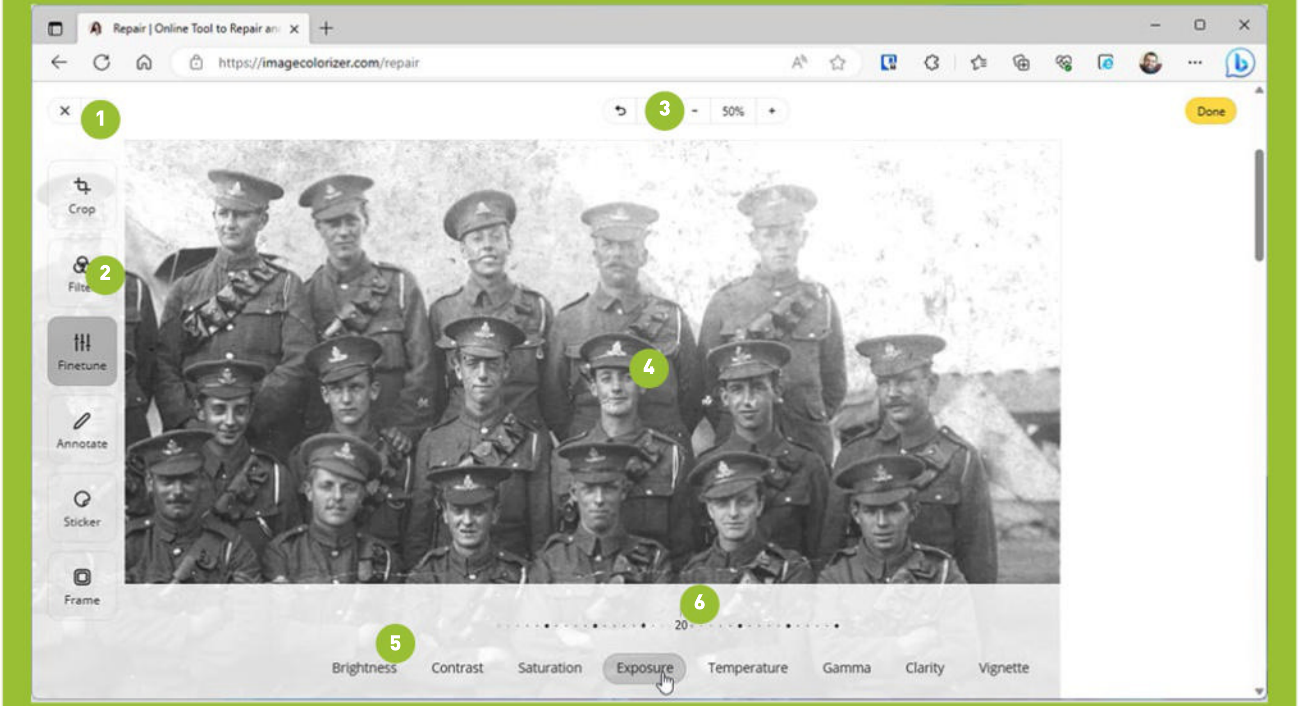
Select Pictures Library to locate and open your first file. Use the Crop section of the app to crop in and straighten skewed images, then select Corrections to access a wide range of tools—again, focus in on specific sections (Light, Color, Effects, and Details) for tweaks that can improve your photos. Select one, then use the slider at the bottom to apply the effect.


auto-levels.png - Adobe Photoshop Express
Get PS Express on Mobile for FREE
Save/Share
Sharpen
Reduce Luminance Noise
Reduce Color Noise
SPLIT TONE

» Photoshop Express offers some quick-fire fixes for photos.

Photoshop Express also offers a Spot Heal brush for removing small blemishes. It's simpler to use than Paint.NET's clone stamp tool, but is less configurable in that you don't get to choose which part of the image to paint over the blemish. After selecting the tool, use the magnifier at the top to zoom into the image as far as it will allow (less than we'd like), then set your brush size and click on a spot or blemish to remove it. If you don't like the result, click undo to try a different brush size or spot.

TWEAK IMAGES IN IMAGECOLORIZER



1. EXIT
Click the Close button to exit without making any changes to your photo, or the Undo All button to reverse all your recent changes and start again from scratch.

2. TOOL SELECTION
Click these to access different parts of ImageColorizer's image editor. Use Crop to reframe your image, while Filters perform a variety of color effects, so can be skipped. The section to focus most of your efforts on is Finetune.

3. UNDO AND MAGNIFICATION
You can undo changes one at a time (plus reapply them). By default, the photo will be resized to fit inside the window, but you can increase its magnification from here or by using your mouse wheel.

4. VIEW UP CLOSE
After you increase magnification, you will have a better look at how the image appears on the page. As always, click and drag the photo around to reveal areas of interest in more detail.

5. FINETUNE CONTROLS
Most of ImageColorizer's Finetune controls focus on lighting levels, but the Clarity slider provides another way to subtly sharpen images.

6. EFFECT SLIDER
Simply increase or decrease the slider to see the effect of the currently selected tool—the image preview updates in real time.

You'll be shown a preview of the effect, which you can reject and try again at no cost, or download for the cost of one credit.

» The second tool is AI Old Photo Restorer. Bear in mind that it's quite restrictive: no more than 2.8 megapixels or 5 MB in size (consider using a JPEG image). After selecting your photo, click 'Output Settings' to push the quality up to 100, then click 'Start to Process'. Once complete, you'll be shown a before and after shot as shown in [**Image B**]. If you don't like what you see, close the image, and try a different version. Note: downloading the image costs two credits.

5 PERFORM MANUAL FIXES

AI can do lots to improve your photos, but it can't do everything. If your photos still need some TLC, or AI doesn't have the effect you hoped, it's time to get your hands dirty. As part of our quest to avoid expensive tools, we direct you towards the excellent Photoshop Express (see the box) and Paint.NET (www.getpaint.net) for making manual adjustments.

» Paint.NET's Adjustments menu aims to fix lighting problems—Auto Levels is a good first port of call, or select Levels and manually adjust both input and output filters using the sliders. The photo updates in real time to help you find the sweet spot.

» We also recommend experimenting with the Highlights/Shadows filter—zoom into your image where detail is a little lacking, and see how the filter can accentuate apparently invisible details from dark parts of the image. When pushing the Highlights slider up, look to move Shadows in the opposite direction, and play around with the Clarity slider, too.

» Paint.NET's Effects menu also has some quick photo fix tools to examine—you'll find these on the Effects menu, such as 'Noise > Reduce Noise', and 'Photo > Sharpen'. Neither are as good as AI-powered tools, but are worth experimenting with if required.

6 REMOVE SPECKLES, SCRATCHES, AND OTHER DAMAGE

Old photos can sometimes be in poor condition, from tiny speckles or scratches to full-blown tears.

© IMAGECOLORIZER

Paint.NET offers tools to fix both types. When it comes to other small blemishes, Paint.NET's clone stamp tool is just the ticket. It works by painting part of the image on top of the afflicted area.

» The trick is to choose a section close to the tear or scratch that's similar to what would have been there originally. Select the clone stamp from Paint.NET's tools palette, then zoom into the affected area. Set the brush size so that it covers the blemish. Examine the area around it and place the cursor over the part you wish to 'clone' on top of the blemish. Hold Ctrl and click—you'll see a circle around the area indicating what part of the image will be used when you click on the blemish.

» The tool takes a little practice—you may need to click several times and move around the blemish (use the Undo button if needed), but the clone stamp can do a reasonable job.

» When it comes to larger blemishes, like deep scratches and tears, the clone stamp tool can be hard work. Thankfully, there's a free third-party plugin—Content Aware Fill—that can speed up the process. Close Paint.NET, download the zip file from forums.getpaint.net/topic/112730-content/ and extract the DLL inside to your C:\Program Files\Paint.NET\Effects folder.

» Re-open Paint.NET and select the area you wish to repair (try the Magic Wand tool and experiment with the Tolerance setting to select irregular shapes). Next, choose Effects > Selection > Content Aware Fill. You'll see the selection filled with colors or tones from the surrounding areas. Experiment with the different settings, as shown in [**Image C**], and you'll see the area change in real-time. Once you're happy with the results, click OK.

7

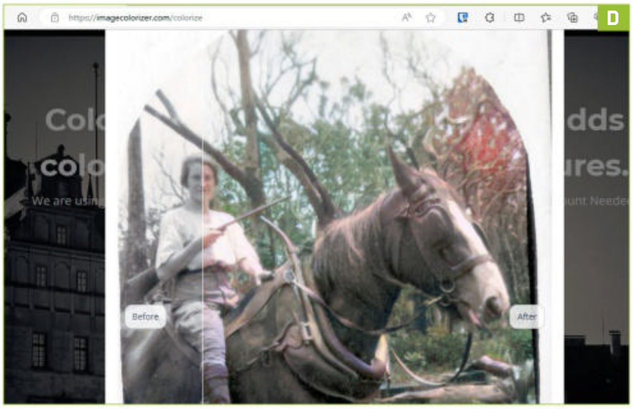
COLOR OLD PHOTOS

As with AI photo retouching tools, the internet is awash with tools offering to transform black and white images into realistic-looking color. These are underpinned by different AI models—one of the most effective is the DeOldify (www.deoldify.ai) model, the latest version of which can be found on the MyHeritage website (www.myheritage.com/incolor).

» Another good choice is ImageColorizer, which does far more than just colorize your images to good effect. Head over to https://imagecolorizer.com and click 'Sign up / Sign-in' to enter your email address. You'll be sent an email link you'll need to use each time you want to log into your free account, which allows you to edit up to 10 photos per month up to a maximum size of 2,000 pixels.

» Five tools are offered: Colorize, Restore, Enhance, Retouch, and Repair. They all work in the same way—upload your photo (PNG format), and you'll see it listed alongside Edit and Start buttons. Edit opens a separate window, allowing you to perform further tweaks. Use this to crop into your image or try further improvements using the Finetune section (focus on the Gamma and Exposure sliders). Click Done to apply any changes.

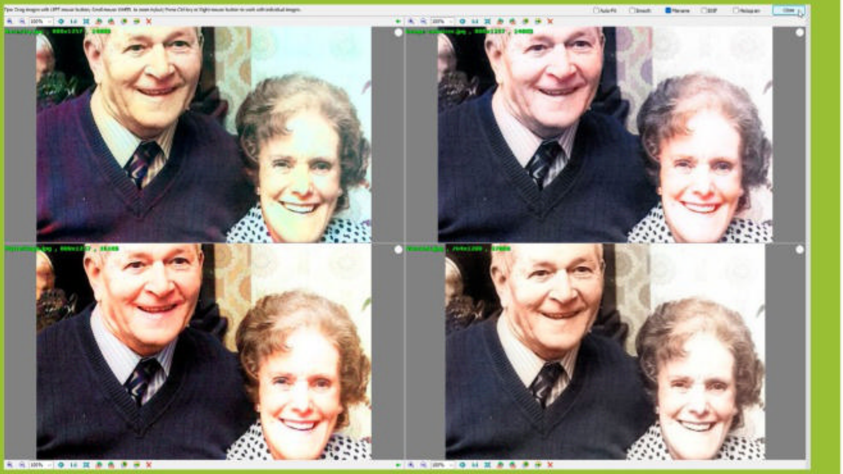
» Once back at the main screen, click Start and wait for ImageColorizer to process your photo—this shouldn't take longer than a minute. Click Preview to open a new tab showing before and after shots overlaid on top of each other (before on the left, after on the right—use the slider as shown in [**Image D**] to compare). Once complete, close the tab, and click Download to save a copy of the photo to your drive.



A BRIEF HISTORY OF COLORIZATION

The history of photo colorization goes all the way back to the 19th century and hand-coloring techniques invented in Europe, but popularized in Japan. The rise of computers introduced tools for injecting color back into photos, but the same process remained: people making judgments about what colors to use.

The rise of machine learning means that AI has made recoloring a quick, hands-off affair. Early AI models like the Colorful Image Colorization project (richzhang.github.io/colorization/) relied on humans to evaluate the AI's attempts to recolor photos, but our innate conservatism resulted in AI models often choosing brown as a 'safe' color. A breakthrough occurred when the DeOldify (www.deoldify.ai) model put the evaluator or 'critic' role in the hands of a different neural network. This GAN (Generative Adversarial Network)—where generator plays a cat-and-mouse game of fooling the critic, which learns to better evaluate colors—results in the generator gaining better insights. The photos thus look more 'realistic' (plausible, as opposed to accurate).



» Different AI models produce different colorizations.

Replace passwords with passkeys

YOU'LL NEED THIS

GOOGLE ACCOUNT
A smartphone
Time required: One hour

PASSWORDS ARE OLDER THAN YOU THINK. Far from arriving with the first computers, they were first used in ancient times to prove a visitor's identity and—assuming the password provided was correct—grant them access to a place or sensitive information.

While passwords may be digital these days, not much else has changed. It's still true that the easiest passwords to remember are the easiest ones to guess or crack, and that if your password should be leaked, it becomes instantly useless.

Unfortunately, many of us opt for the path of least resistance. Rather than thinking of unique passwords for every site, we tend to use the same few words, numbers, and phrases. When one of these leaks online, it's like dropping a skeleton key on the street: it opens the door not only to the first account for which it was used, but all the others to which it was subsequently applied.

That's why tech companies like Google, Apple, and Microsoft have spent years working on more secure alternatives, mainly biometrics such as fingerprint, facial, and voice recognition. These are much more difficult than passwords to steal and imitate. The latest alternative are passkeys. Here, we explain why and how you should start using them. **–NIK RAWLINSON**

1 WHAT IS A PASSKEY?

A

Google began rolling out passkeys to personal Google accounts in May, having announced its support for the technology—along with Apple and Microsoft—last summer. Microsoft calls passkeys "a safer, faster, easier replacement for your password", while Google has declared their arrival "the beginning of the end of the password".

» Passkeys are being rolled out to a range of devices and services, including PayPal and eBay, although they are yet to be adopted by many of the most popular websites and apps. That said, with the endorsement of tech's biggest names, we expect that to change soon. By setting up your first passkey, you'll be familiar with the process when other services follow suit.

» We're going to show you how to set up a passkey to secure your Google account, but first we'll explain what passkeys are and why you should consider using them. If you're going to make fundamental changes to your security setup, it's important to know what you're doing.

» The technology upon which passkeys are based has been around for years. Many of you may know of YubiKey [**Image A**], which is a small plastic key containing a chip that lets you store up to 25 unique codes. You can use these to unlock a site or device, sometimes in combination with a password. Unless you have the key, you can't access whatever it's been used to lock—for example, your online bank account or PC. Because there's only one key containing your code, it's impossible for your passwords to leak online.

» Passkeys are a little different because the 'key' in question isn't a physical device, but a code stored by a device. Because it is software, you can back it up and transfer it between devices, which comes in handy when you come to buy a new phone.

2 HOW DO PASSKEYS WORK?

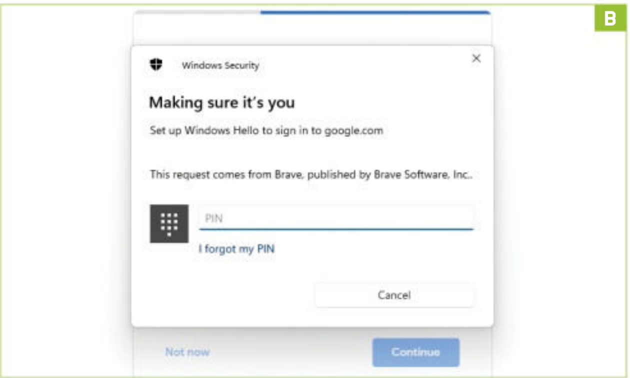
If you've ever set up two-factor authentication (2FA), you're already using a similar system, albeit one that's not as secure. When logging into a 2FA-protected account, you'll usually be sent a code by text message, and asked to type it back into the site to confirm your identity.

» In theory, this should be very secure, because hackers would need both your password and phone to receive a text message before they could access your account. In practice, it's far from perfect, as some German bank customers discovered in 2017. Hackers set up a fake telecoms provider and used it to redirect 2FA codes from the bank to their own computers. They then used these codes to authorize illegal money transfers.

» This wouldn't be possible with passkeys, because there are no codes to send, receive, and type back. Instead, the code is stored in a phone or computer, which the person logging in unlocks using their biometric data—a fingerprint, facial recognition, and so on.

» Once the device with the code has been unlocked, it will communicate with the website that the user is trying to visit to confirm they've verified their identity. Upon receiving this confirmation, the site will grant access.

» If you're having trouble visualizing this, imagine you've visited your bank in person, but forgotten to take your ID. The bank is naturally cautious when you ask the cashier to access your account, so they place a video call to your doctor, who is considered a trusted third party. The doctor recognizes you (effectively using biometrics,


B

Windows Security

Making sure it's you

Set up Windows Hello to sign in to google.com

This request comes from Brave, published by Brave Software, Inc.

© GOOGLE, MICROSOFT

because they recognize your face on the video), and confirms your identity. Satisfied with this, the cashier agrees to open up your account, and you can withdraw the cash you need.

3 WHAT IF YOU LOSE YOUR PHONE?

If you lose your phone, your passkey could fall into someone else's hands, but there's no reason to panic, as they won't pass the biometric tests that authorize its use.

» Depending on your setup, you shouldn't be locked out of your accounts when you lose your phone. As we mentioned, there's a difference between physical devices like YubiKey and the software-based passkeys we're discussing here. Not only can they be backed up and transferred, but they can also be synchronized between devices.

» So, if you have an iPhone and an iPad, for example, you can sync passkeys between them using iCloud Keychain (pictured above), and use them to authorize access to protected sites or apps on either device.

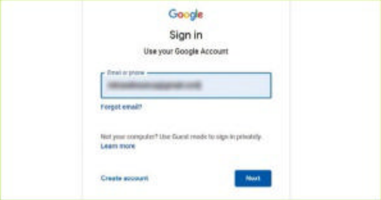
4 CAN YOU SET UP A PASSKEY WITHOUT A PHONE?

Yes. If you don't have a phone with biometric functionality, you can still set up a passkey with Windows Hello. This is a feature of the operating system that uses a PIN, fingerprint, or facial recognition.

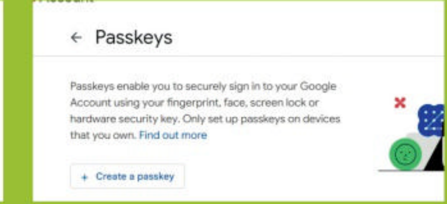
» If this is available on your computer, you'll be prompted to set it up when you sign into your account with a 'Simplify your sign-in' screen. Click 'Continue', then use the facial ID, fingerprint, or PIN **[Image B]** you've set up with Windows to confirm your identity. You'll then be able to use it to log into your Google Account, or any other account for which you've set it up. ⏻

SET UP A PASSKEY FOR YOUR GOOGLE ACCOUNT

Now that you know what passkeys are and how they work, it's time to set up your first one. We'll explain how to use Google's passkeys to sign into Gmail, Google Drive, and other services provided by the company.

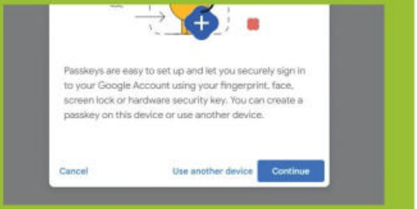

Google
Sign in
Use your Google Account
Email or phone
Forgot email?
Learn more
Create account
Next

1. OPEN YOUR BROWSER
Open a new browser window on your computer (not phone) and visit g.co/passkeys. Log into your Google account using your usual address and password.


Passkeys
Create a passkey

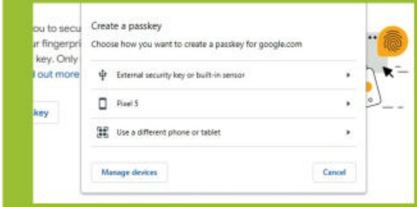
Passkeys enable you to securely sign in to your Google Account using your fingerprint, face, screen lock or hardware security key. Only set up passkeys on devices that you own. Find out more

2. ACTIVATE PASSKEYS
If you've previously signed into this account using an Android phone, it will already have been set up with a passkey that's yet to become active. To start using it to log into your account instead of your password, tap 'Use passkeys'. To set up a new passkey (as we're doing here), tap 'Create a passkey'

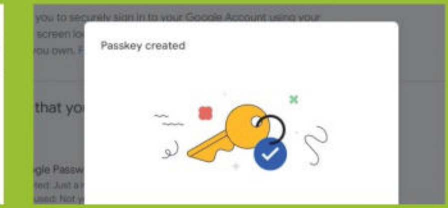

Cancel
Use another device
Continue

Passkeys are easy to set up and let you securely sign in to your Google Account using your fingerprint, face, screen lock or hardware security key. You can create a passkey on this device or use another device.

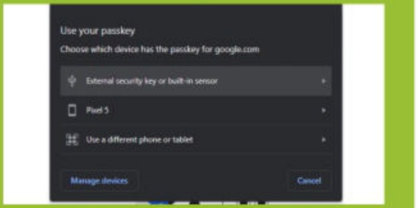
3. GRAB YOUR PHONE
Passkeys rely on biometric security, which not all devices have, like the laptop we're using. However, our phone does, so we'll use that as our passkey device. If you're doing the same, make sure your phone and computer have Bluetooth enabled, then click 'Use another device'. If your browser asks if you're happy for it to reveal information about your security key, authorize it.


Create a passkey
Choose how you want to create a passkey for google.com
External security key or built-in sensor
Pixel 5
Use a different phone or tablet
Manage devices
Cancel

4. SET UP YOUR PASSKEY DEVICE
Select the device you want to use to store your passkey. This will need to be a laptop or desktop PC running Windows 10 (or macOS Ventura), or a mobile device running Android 9, iOS 16, or later. It will also need Chrome 109 or later, Safari 16 or later, or Edge 109 or later, plus screen lock activated. If you want to use a passkey on your phone to sign into another computer, it will need Bluetooth. We're going to set up our Pixel 5, which is listed. If it wasn't, we'd click 'Use a different phone or tablet'.


Passkey created

5. IDENTIFY YOURSELF
Google will now send a notification to your phone. Tap it in order to start the setup process and confirm that the address shown on the screen is the one for which you're creating a passkey. After this, tap 'Continue', followed by 'Use screen lock' to authorize the phone's built-in locking feature as the key for your account. When you are prompted to do so, touch the fingerprint sensor to confirm your identity, and the box on your PC should update to show that the passkey has been created.


Use your passkey
Choose which device has the passkey for google.com
External security key or built-in sensor
Pixel 5
Use a different phone or tablet
Manage devices
Cancel

6. TRY IT OUT
Test your passkey —this can be done by logging out of your account on the computer, then subsequently logging into Gmail. Rather than asking for your password, Gmail will instead try to use your passkey. Click 'Continue', then click the device that is being used to store the passkey (in our case, this is Pixel 5). Check your phone for a notification. Tap it, then unlock the phone using your fingerprint, and Gmail will finish logging in on your computer.

LAB NOTES

GUY COCKER, EDITOR-IN-CHIEF

Do You Think I'm 6E?

Finally upgrading from decade-old WiFi

THIS MONTH, I took a look at Netgear's Nighthawk A8000 (see review, page 87), a USB dongle that allows you to upgrade any Windows 11 device to WiFi 6E. The problem is that I don't even have WiFi 6 at home, let alone the latest WiFi 6E standard (let's just leave WiFi 7 out of this for now). Luckily, Netgear were kind enough to loan me their Orbi 960 system, a top-of-the-line ($1,100 for the two-satellite kit I needed to cover my apartment) mesh system that looks as good as it is easy to set up. But then again, for that money it should probably make me a caramel latte as well.

Anyway, I digress. Like many people, I've come to take WiFi for granted—I absolutely depend on it for work and play day in, day out, but I also kind of forget it's there. As a result, I've been running a WiFi 5 system for the five years since I moved in, and was surprised when I learned that's now nine year-old tech. It's fine for most tasks, but there are always those little annoyances, like the fact the signal won't quite reach the back of the garden where I want to have a smart speaker playing music at BBQs, or the front door security camera that's always dropping in and out and sending annoying alerts to my phone.

The new Orbi system fixed both those things, of course, but then you'd expect it to. Still, it's impressive to see my WiFi 6E-enabled Samsung Galaxy S23 Ultra now picking up a signal from across the street, so the garden is absolutely covered now. But now I'm starting to get restless with the 150Mbps broadband I've been making do with for years, and eyeing up the 1Gbps or even 3Gbps package offered by my provider. It's very much like when you try a luxury car or a proper HiFi system—you were fine with what you had, but once you've had a taste of the best, it's hard going from champagne back to prosecco.

The Orbi 960 offers luxury WiFi at a luxury price.

© NETGEAR

SAM LEWIS

Staff Writer

This time last month, I wrote about installing Apple CarPlay and mentioned some of the struggles that came with it. On the whole, it's been fantastic having this interface. It makes driving a breeze, and it's my favorite solution to an in-car-infotainment system by far—no offense Android Auto. Yet, due to my Android Double Din head unit having an ancient mini-USB port on the front, I had to use a mini-USB to USB Type-A adapter, which I admit was quite a cheap one.

It didn't take long for this to cause a few headbanging moments. My Maps and Apple CarPlay would cut out due to a loose connection and this would only happen when I crucially needed my navigation. Let's just say I have had a few back-and-forth trips up highways, plugging and unplugging this lead just to get it working again! Long story short, I had to order another adapter which, fingers crossed, is much better this time and should last longer too.

In summary, don't always pick the cheapest adapter you can find on Amazon that has next-day delivery. 'Buy nice or buy twice' is one big life lesson that I've learned over the last month thanks to this! Of course, always try to save money where you can, but don't waste your hard-earned bucks trying out the cheap alternative with barely any reviews for the sake of $10, because it will come back to bite you!

As your appointed GPU broker, I make the ASRock Challenager D RX 6700 XT a strong buy.

Editor's Pick: ASRock Challenger D RX 6700 XT

The pinnacle of gaming graphics cards?

THIS IS NOT a review. We have review pages for that. Indeed, this is not really a new product. Certainly, the graphics chipset at its heart is years old, so it says a lot about the state of PC gaming that this might be the best graphics card you can buy.

That's not because of any particular technical innovation. This is essentially a vanilla AMD Radeon RX 6700 XT board: it runs the reference 2,581MHz boost and 16Gbps memory clocks, and has the standard 40 compute units and 64 ROPs. No, what makes this special is that it's currently available for $310, making it a fantastic buy in today's market.

It's easy to forget how much people were paying for these things. Launched with an MSRP of $480 in March 2021, the selling price of a 6700 XT back then was more like $1,200—certainly over $1,000.

What's more, Nvidia's recent GPU launches have only made this look more appealing. Take the new Nvidia GeForce RTX 4060 Ti. For pure raster performance, there's really nothing in it versus the 6700 XT, but the RTX 4060 Ti is a $399 GPU. Okay, you can get it for a little less than that, but it's at least 25 percent more expensive.

Of course, that's how things stand. As you look to the future, the 4060 Ti's 8GB of VRAM and 128-bit memory bus are only likely to become more problematic. VRAM and bandwidth requirements for games are going to increase, not decrease. You could argue the Nvidia board has other advantages, that Nvidia's DLSS scaling tech is definitely better than AMD's FSR, and that the 4060 Ti is better at ray tracing.

Indeed, AMD has no answer to Nvidia's frame-gen tech in DLSS 3. But then, frame-gen is far from universally supported. It's not the same as adding real additional performance, and doesn't work as well on Nvidia's smaller GPUs like the 4060 Ti as it does on bigger beasts like the 4080 and 4090. $310 for a 12GB 6700 XT versus $390 for a 8GB 4060 Ti? No contest.

Then there's the upcoming RTX 4060 non-Ti. It's days away from launch as I write. It's also pretty horribly cut down versus the 4060 Ti, and even Nvidia is only claiming 20 percent uplift with the 4060 over the old 3060. The RTX 4060 is going to launch at $299, and it's hard to see how a 6700 XT won't completely tear it apart.

Ironically, another reason why this Asrock card is a great buy is the mediocre job AMD has done with its latest RDNA 3 graphics architecture in the new Radeon RX 7000 series boards, including the 7900 XT, 7900 XTX, and 7600. RDNA 3 isn't a disaster, but it's not a huge step over RDNA 3. You don't have to worry about buying a 6700 XT today, only for AMD to roll out a 7700 XT next month.

The reality is that the 7700 XT will be faster. However, RDNA 3 isn't a game changer. Given the 7700 XT is going to sell for somewhere around $150 to $200 more than this 6700 XT, it needs to be at least 50 percent faster to offer better value. And we all know that it's not going to be 50 percent faster.

So, this is one of those rare occasions in the GPU market where you can buy today with almost no risk of having your purchase look outdated in short order. It's probably going to take the successor to the 7700 XT, let's call it the 8700 XT, to make a $310 6700 XT feel like very old news. And that's a couple of years away. So this ASRock Challenger D RX 6700 XT really is about as strong a buy recommendation as there has been in absolutely years. **–JL**

$310, www.asrock.com

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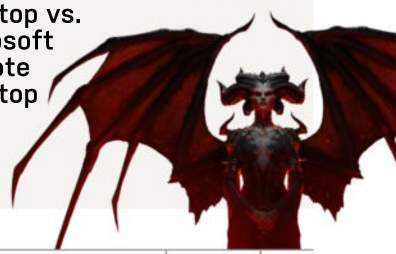

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Nvidia GeForce RTX 4060 Ti

The tightly regimented mid-range Ada card delivers no surprises

The RTX 4060 Ti doesn't offer a generational leap forward, other than DLSS 3 and Frame Generation.

IT'S FINALLY HAPPENED. We've hit an Ada Lovelace GPU that's actually priced at the same level as the equivalent last generation card. Yes, the Nvidia RTX 4060 Ti is on sale with a $399 MSRP that matches the RTX 3060 Ti of the Ampere generation. That was one of the best GPUs of the whole Ampere range, and one of the best mid-range cards ever made.

With this Ada equivalent of the RTX 3060 Ti, then, we ought to be looking at another stellar, almost-affordable green team graphics card. The RTX 4060 Ti is a card that offers more in terms of performance and features than the one it's ostensibly replacing. My issue, however, is over what counts as GPU equivalence in these complex times.

Should you classify a GPU in terms of its objective gaming performance, counted as a modest percentage increase over a card from a previous generation, or do you classify it in terms of the level of graphics silicon deployed in a given card? In this, I feel I might be at odds with how Nvidia measures equivalence itself.

The RTX 4060 Ti is a tightly regimented graphics card, rigidly taped out to hit a certain performance level as cheaply as possible, and to provide Nvidia with an avenue for any AD106 GPUs that don't make the grade as higher-spec mobile RTX 4070 chips.

It has been designed to beat an RTX 3060 Ti by as tight a performance margin as possible, but without DLSS 3 and Frame Generation, it certainly doesn't feel like a particularly exciting generational upgrade over the old Ampere card. To me, it doesn't really feel like a slice of silicon that's really worth the $400 sticker price, even if the performance on offer arguably is.

There are a lot of technical details that will annoy those who care about the silicon they're getting, rather than the end result. For example, the RTX 4060 Ti uses the same AD106 GPU as Nvidia has introduced with the RTX 4070 mobile GPU, but in the desktop part it has chosen to cut it down from 4608 CUDA cores and 36 streaming multiprocessors (SMs) to 4352 CUDA cores and 34 SMs. There are also fewer CUDA cores and a narrower memory bus than on the 3060 Ti, almost half the render output units (ROPs), and fewer texture and ray tracing units.

PERFORMANCE LEVELS

There are some wins, however. The last-gen RTX 3060 Ti sported just 4MB of L2, while the RTX 4060 Ti rocks up with 32MB. As we've seen across the new GPUs and CPUs of the past year or so, adding a ton of extra cache does have an impact on the gaming performance of your machine.

In terms of its gaming performance, the RTX 4060 Ti does what's needed of it, and arguably little more. If you're buying this $399 graphics card to play at 1080p then you'll be happy that it can outperform the RTX 3060 Ti of the previous generation by a relatively comfortable margin. At most we saw a 19 percent delta over the last-gen Ampere card in Cyberpunk 2077 and F1 22, but in general the boost was a lot smaller.

This performance, though, is either slower or equal to the 1080p performance you can get from the RTX 3070. DLSS 3 and Frame Generation are the secret sauce on the RTX 4060 Ti, however, so you can even make a stab at 4K gaming.

What is obviously next-gen is the efficiency of this GPU. The RTX 4060 Ti runs at a far lower power draw. On average we were looking at 157W vs 200W with the RTX 3060 Ti, and that's with the Ada GPU operating at nearly a full 1GHz faster than the old Ampere chip.

The RTX 4060 Ti is a finely crafted, super-efficient graphics card, built to hit a specific performance level with as small a silicon budget as possible. Owing to its performance lead over the similarly priced RTX 3060 Ti, it is now the mid-range GPU of choice—mainly because there is no other choice! **–DAVE JAMES**

RAM BENCHMARKS

	RTX 4060Ti	RTX 3060Ti	RX 6700 XT
Cyberpunk 2077 RTX (fps)	**44**	37	25
F1 22 RTX (fps)	**106**	105	101
Far Cry 6 RTX (fps)	**106**	105	101
Metro Exodus Enhanced (fps)	**91**	77	71
Warhammer Total War III (fps)	**105**	97	96
Red Dead Redemption 2 (Vulkan) (fps)	**102**	92	92

Best scores are in bold. Our test bench consists of an Intel Core i9 12900K, Asus ROG Z690 Maximus Hero, 32GB G.Skill Trident Z5 RGB DDR5-5600 RAM, 1TB WD Black SN850/4TB Sabrent Rocket 4Q SSDs, and Windows 11 22H2. All tests were done at 1080p resolution at highest or ultra settings.

VERDICT

8

Nvidia GeForce RTX 4060 Ti

+ DEEP LEARNING Matches RTX 3060 Ti for price; DLSS 3 and Frame Generation support.

− DEEPLY STUPID Sub-20 percent delta over RTX 3060 Ti at 1080p; Low-end GPU at mid-range price; Generally slower than an RTX 3070.

$399, www.nvidia.com

SPECIFICATIONS

GPU	AD106
Architecture	Ada Lovelace
Lithography	TSMC 4N
CUDA cores	4352
SMs	34
RT Cores	34
Tensor Cores	136
ROPs	48
L2 cache	32 MB
Boost clock	2,540 MHz
Memory	8GB GDDR6
Memory interface	128-bit
Memory bandwidth	288 GB/s
Die size	187.8mm²
Transistors	22.9B
TGP	160W

8GB will become a bottleneck—it's just a question of how soon.

AMD Radeon RX 7600

Shakes up the entry-level gaming GPU market

FOLLOWING THE RELEASE of AMD's Radeon RX 7900 XT and RX 7900 XTX, you might have expected AMD to follow a traditional release cadence and produce an RX 7800 or RX 7700-series card. Not this time. Surprisingly, the second desktop RDNA 3 GPU is the Radeon RX 7600.

After years of massively inflated GPU pricing, is the RX 7600 the card the market has been crying out for? At $269, the RX 7600 is easily the cheapest of the current generation of GPUs from either AMD or Nvidia, though it's important not to overlook Intel's Arc cards either, at least from a value perspective. Nvidia is set to respond with the pricier $299 RTX 4060 in July, so for now, the RX 7600 is touted as being a solid option if you're after a card on a tight budget.

I was surprised at how small the Radeon RX 7600 reference card is. In fact, it's pretty much tiny compared to some of the triple-slot behemoths we've seen. That alone will impress some buyers with compact cases looking to make use of its impressive display capabilities and media engine.

Then there's the elephant in the room: AMD did miss a trick by sticking with 8GB of VRAM. It's enough for 1080p in almost every current game, but can we say that two years from now? What if *Grand Theft Auto 6* turns out to be a VRAM-hogging monster? 192-bit and 12GB of VRAM would have given the card more appeal and a longer life. We're seeing popular cards like the GTX 1060 and RTX 2060 6GB running into limits now, and there's no reason that the RX 7600 won't hit similar limits in a couple of years' time.

But that's in the future. For now, the RX 7600 is a competent, though not stellar, 1080p performer. It's easily capable of high framerates in eSport titles and maintaining that important 60 fps level at 1080p in almost every game. It is still the dominant gaming resolution, and the RX 7600 does offer a decent all-round upgrade over the aforementioned cards.

There are things I love about the card. It's got a good media engine that includes AV1 encode and decode support up to 8K, DisplayPort 2.1, and support for up to four simultaneous 4K displays at 144Hz each. That makes it a very capable HTPC or productivity GPU. There's nothing available (yet) at its $269 price point that ticks all of those boxes.

As the RX 7600 is an RDNA 3 GPU, it's got the same fundamental building blocks and microarchitecture as the RX 7900 series models. Compared to the RX 6000 family, you get things like Improved ray tracing, dedicated AI hardware, the updated media engine with AV1 decode support, and DisplayPort 2.1.

As AMD is positioning the RX 7600 as an RX 6600 replacement, it would be remiss not to mention the increase in power consumption to 165W, up from the 132W of the RX 6600. It's not a dramatic increase, but it is around RX 6600 XT levels and higher than the RTX 4060 Ti, so it will be higher again over its upcoming Nvidia competitor, the yet to be released RTX 4060. At least the RX 7600 doesn't require a power adapter; it makes do with a single 8-pin PCIe power connector.

We can expect AMD to release FSR 3 at some point this year. It's set to bring its own version of Frame Generation to the table, and is supposed to rival Nvidia's DLSS 3. The RX 7600 is certain to support FSR 3. If you appreciate the extra performance FSR 2 brings, FSR 3 promises to be better.

The AMD Radeon RX 7600 has its share of positives, and offers value for money for long-suffering gamers. However, it doesn't do enough to excite, and it faces tough competition from all sides. We're left wishing that the RX 7600 brought a little more to the fight. **–CHRIS SZEWCZYK**

VERDICT

7

AMD Radeon RX 7600

⊕ **ENTRY LEVEL** Good pricing; Compact size; Display support and media engine; Quieter than expected.

⊖ **BOTTOMING OUT** Unexciting performance; Middling memory spec; Power consumption is relatively high; Tough competition—last-gen cards are getting cheaper.

$269, www.amd.com

RAM BENCHMARKS

	AMD Radeon RX 7600	RTX 3060 (MSI Gaming X)	Arc A750
Cyberpunk 2077 RTX (fps)	22	**31**	27
F1 22 RTX (fps)	**60**	54	58
Far Cry 6 RTX (fps)	**96**	81	75
Metro Exodus Enhanced (fps)	66	58	**80**
Red Dead Redemption 2 (fps)	**82**	70	81
Total War: Warhammer III (fps)	**81**	72	68

Best scores are in bold. Our test bench consists of an Intel Core i9 12900K, Asus ROG Z690 Maximus Hero, 32GB G.Skill Trident Z5 RGB DDR5-5600 RAM, 1TB WD Black SN850/4TB Sabrent Rocket 4Q SSDs, and Windows 11 22H2. All tests were done at 1080p resolution at highest or ultra settings.

SPECIFICATIONS

GPU	Navi 33
Architecture	RDNA 3
Lithography	TSMC 6nm
Stream Processors	2048
Compute Units	32
Ray Accelerators	32
AI Accelerators	64
ROPs	64
Infinity cache	32MB
Boost clock	2,625MHz
Memory	8GB GDDR6
Memory interface	128-bit
Memory bandwidth	288 GB/s
Die size	204mm²
Transistors	13.3B
TGP	165W

Asus has made a genuinely next-gen Steam Deck in the ROG Ally.

Asus ROG Ally

The first in line for the Steam Deck's throne

THE ASUS ROG ALLY is really, really good. So good, in fact, that it might just be the best budget gaming PC you can buy right now, and may even make cheap gaming laptops an irrelevance, too.

Asus has made a genuinely next-gen Steam Deck in the ROG Ally. That's probably the highest praise you can give a modern handheld gaming PC. It might sound mean, but I'm surprised that Asus has really got what made the Deck such a good machine. It has priced it smartly, delivered a fantastic user experience—occasional Windows-based niggles aside—and made it a very open platform.

The performance of the system itself is what sets it apart from Valve's inaugural handheld, though. That AMD Z1 Extreme APU is a stunning piece of mobile silicon, with a CPU heart capable of easily outstripping modern Alder Lake Core i5 and Core i7 processors. That, along with its surfeit of DDR5 memory and PCIe 4.0 SSD, makes it a supremely responsive system and pleasure to use.

The 12 CU RDNA 3 GPU is also mighty impressive for an integrated GPU, too. Native 1080p gaming is absolutely possible if you drop it down to medium or low settings. Testing Elden Ring on the ROG Ally even got me back into the game again because it was delivering such a good experience whether docked to my TV or in my hands.

Honestly though, the thing that will grab you the instant you boot up your ROG Ally is the IPS-level 1080p screen. It's about as punchy as you could hope for from a handheld device.

It's not without issues, however, chief of which is the poor battery life. This is the only part of the picture where it feels like Asus has missed the mark, delivering gaming laptop-level battery life that isn't quite good enough in a genuine handheld.

No matter that it's running on Windows, without the need for Proton game support to circumvent Linux—you still need the driver software to be there. Plus, I had a few times where the GPU component of the chip wasn't doing its job in a particular game, and it would either crash or simply not perform.

Basically, it really didn't like *Star Wars*. Neither *LEGO Star Wars: The Skywalker Saga* or *Jedi: Survivor* got anywhere near playable; they were like slideshows.

Given how well it performs in general, however, that feels more like a surmountable software problem than a fundamental issue. On the whole, Asus has done an incredible job of making this desktop OS utterly usable on a handheld, largely because of what it has learnt from the Steam Deck, it must be said.

By pricing it at $699, just $50 more than the equivalent 512GB Steam Deck, Asus has effectively rendered the top spec Deck obsolete. Because of its utility as a desktop gaming PC when docked to a monitor and peripherals, it's also arguably the best budget gaming PC you can buy. You may get higher performance from a cheap RTX 3050 system priced only a little more than this, but you won't get the CPU performance, the same level of memory support, or the versatility of being able to take it anywhere.

The supporting internal cast is equally impressive. There is 16GB of LPDDR5 running at 6,400 MT/s and in this version a 512GB PCIe 4.0 SSD. It's a quick SSD, too, with storage performance not far off the current generation of laptops.

I'm a fan of the ROG Ally, and I did not expect to be. It's not cheap enough to be a companion to your high-end gaming PC, but it could replace a budget desktop machine, and maybe even a cheap gaming laptop. The ROG Ally is fast, responsive, good-looking, and is a genuine gaming PC on the go. **–DAVE JAMES**

VERDICT

9

Asus ROG Ally

+ EASY ALLIES Impressive gaming performance; Great screen; Excellent docked experience; Really quiet; Lightweight.

− HOSTILE TAKEOVER Weak battery life.

$699, rog.asus.com

BENCHMARKS

	Asus ROG Ally	Razer Blade 15 Advanced (10th Gen)	MSI Cyborg 15
Cyberpunk 2077 RTX (fps)	5	33	**38**
F1 22 RTX (fps)	13	**60**	52
Hitman 3 Dubai GPU Test (fps)	48	**175**	124
Horizon Zero Dawn (fps)	30	97	**98**
Metro Exodus Enhanced RTX (fps)	16	**64**	46
3DMark Time Spy Extreme (GPU Index)	1,323	**4,796**	3,411

Best scores are in bold. All tests were done at 1080p resolution at highest or ultra settings.

SPECIFICATIONS

Processor	AMD Z1 Extreme
CPU architecture	Zen 4
Cores	8
Threads	16
Boost clock	5.1GHz
GPU architecture	RDNA 3
Compute units	12
Shaders	768
Boost clock	2.7GHz
VRAM	4GB
Memory	16GB LPDDR5-6400
Screen	7-inch IPS-level
Resolution	1080p
Refresh Rate	120Hz
Peak brightness	500 nits
Storage	512GB PCIe 4.0 SSD
I/O	1x ROG XG Mobile and USB Type-C combo port, 1x 3.5mm audio, 1x UHS-II microSD
Battery	40Wh
Weight	608g (1.34 lbs)

This laptop is incredibly powerful at a great price—just expect some cut corners.

Asus ROG Strix SCAR 17 (2023)

Number-crunching beast on a budget

AMD'S NEW RANGE of Zen 4 mobile chips are the finest number crunchers that you'll find in a gaming laptop. That makes this Asus ROG Strix Scar 17 one of the most powerful gaming laptops I've ever tested. This is also the most affordable RTX 4090 machine I've seen in this generation, and one of the best-performing RTX 4090 machines I've seen, which is a combination that makes this laptop easy to recommend.

Just bear in mind that this isn't at the top end of Asus's ROG offerings. That means there's no ROG Nebula Display like on the excellent Zephyrus G14, meaning this Scar 17's display looks dull, and maybe a little tired. I also feel like the machine doesn't quite have the quality I've been used to from the other Asus laptops I've looked at. Trackpads are historically bad on gaming notebooks, but this one is painfully poor. And then there's the fingerprints—the matte finish looks nice out of the box, but give it ten minutes of use, and it's going to be permanently stained by the natural oils of your skin.

You absolutely do need to be plugging it in, because despite that 90Wh battery, it really doesn't last long away from a wall socket. If you're gaming, consider the battery like some sort of uninterruptible power supply rather than something to rely on for long.

But that's where the sadness stops, because otherwise this is a really impressive gaming laptop that makes the ridiculous MSI Titan look even more dumb. The Asus is nearly $2,000 cheaper, and outperforms it in practically every metric that matters.

The key spec, as always in a gaming notebook, is that of the CPU/GPU combo. We've already spoken in great length about the mobile RTX 4090, decrying its misnaming as an RTX 4080 in a thin disguise, but the mobile AMD CPU is the big new thing here.

It's AMD's latest Zen 4 architecture brought into the laptop realm, and it's pretty damned special, beating the competing Intel 13th Gen chips used in comparative systems, sometimes by a long way. It's a 16-core, 32-thread processing monster that so far hasn't burned up inside the confines of this surprisingly slight chassis.

The nominal clock speed of the chip is just 2.5GHz, with a boost clock of 5.4GHz, and that's actually a reliable boost, too, because I was reliably seeing the chip ramping up to that level during single-core loads in my testing. In heavily multi-threaded loads, I was seeing a regular 4.7GHz, which is no mean feat. I repeat, we are talking about 16 full Zen 4 CPU cores here.

So yeah, thanks to AMD's new Dragon Range Zen 4 processors, this is the most powerful gaming laptop I've ever tested that I could actually put up with. The 1440p panel isn't bad; it's responsive, and has a 240Hz refresh rate, but it doesn't feel particularly bright or vibrant either on the desktop or in game.

The machine isn't comfortable to type on for long periods, with the defined edge at the front of the laptop really digging in as I type this review. And oh boy, that trackpad has been really getting to me. It flits between too responsive and not responsive enough. I'll be trying to use a two-finger scroll to get around a web page or document, and it's constantly registering a press.

It does like to make itself heard, too. I'm not talking about its speakers, which are fine as laptop drivers go, but about the noise of the system's cooling array. It's effective, with the CPU staying well below the mark the competing Intel chips are hitting, but it sure is loud doing it.

The Scar 17 is one of the fastest and most powerful gaming laptops I've tested. If that's all you care about then this is the machine for you. For me, the ergonomics make it feel like a second-tier system, despite the fact it can outperform far more expensive gaming laptops. **–DAVE JAMES**

VERDICT

8

Asus ROG Strix SCAR 17 (2023)

➕ **ROG & ROLL** That new AMD CPU is a star; RTX 4090 can flex its gaming muscles; Relatively slim chassis for a 17-incher; More affordable than equivalent specs.

➖ **SCAR TISSUE** Poor ergonomics; Terrible trackpad; Weak battery life; Can get loud.

$3,500, rog.asus.com

BENCHMARKS

	Asus ROG Strix SCAR 17 (2023)	MSI Titan (RTX 4090 175W)	Razer Blade 16 (RTX 4090 175W)
Cyberpunk 2077 RTX (fps)	44	**47**	42
F1 22 RTX (fps)	**85**	76	82
Horizon Zero Dawn (fps)	**159**	146	132
Metro Exodus Enhanced RTX (fps)	95	**106**	86
Hitman 3 Dubai GPU Test (fps)	223	**225**	207
Hitman 3 Dartmoor CPU Test (fps)	144	**150**	115

Best scores are in bold. All tests were done at QHD/+ resolution at highest or ultra settings.

SPECIFICATIONS

Model	G733PY
CPU	AMD Ryzen 9 7945HX
GPU	Nvidia RTX 4090 (175W)
RAM	32GB DDR5-4800
SSD	1TB SK Hynix PCIe 4.0
Screen	17.3-inch QHD
Refresh rate	240Hz
OS	Windows 11

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MSI Z790I Edge Wi-Fi mini-ITX

The best mobo for your small form factor PC?

This is one of the best options for building with Intel chips.

TO CALL ANYTHING the best is a strong opinion, to say the least. Of course, it's a very subjective thing to say, and will vary depending on your personal preferences, but if you're looking for a mini motherboard, this one has plenty of tricks up its sleeve. With a mobo, you must consider an element of futureproofing too, as it's the most awkward component to swap out for obvious reasons. You can trust us on that one too—we've taken a fair few mobos out of builds in our time! Selecting a dependable one for your system is vital—you need to pick the right backbone for your PC to ensure your components work in harmony with one another. This MSI Z790I Edge may be one of the best to choose from if you want to build using the latest Intel chips, but in a small case.

Kicking things off with the aesthetics of the board, MSI has nailed it here with the silver/white color scheme. The mini-ITX design helps, as it means that most of the PCB has been cut off and the majority of the remaining board consists of heatsinks and panels. There also isn't too much gamer-inspired design—just the MSI logo and the MPG and Edge branding. It could certainly be used in a more productivity-based system. We've featured this motherboard in our cover build found on page 16—unfortunately for us though, its design was hidden away underneath our case, but as it goes, this is a good-looking mobo!

If we turn our attention to the side of the motherboard, we can take a look at the selection of ports on offer. Again, for this size, it offers a lot. There are a total of six USB Type-A ports, one USB Type-C, an ethernet port, one HDMI, one DisplayPort, Mic-in, Line-in, and Line-out ports. Now, that's a healthy selection. This I/O panel is pre-installed on the board and finished in the same silver/white color scheme as the rest of the motherboard.

We're now heading back to the main part of the board and some of its core features. This is, of course, a Z790 board, which is the top chipset available for Intel processors. This is perfect if you want to use some of the top-end Intel chips, such as the i9-13900K, but it supports the whole 13th gen lineup. Having the best chipset will ensure that you have the most futureproofed motherboard, and it should last you a few generations without needing to be changed. Other stand-out features include its DDR5 support. Sure, it only has two slots, but it supports RAM with up to 96GB of capacity and at speeds of up to 8000MHz. Granted, that is with some overclocking, but still, that amount of RAM should be enough for anyone.

The board also supports up to three M.2 slots. This allows for a ton of storage on your mini-ITX machine, something that's very important if you 're using it as a games console alternative as we did this month. Connectivity is another plus for the MSI Z790I Edge Wi-Fi, as it supports—the clue's in the name—Wi-Fi 6E, and also Bluetooth 5.3. This is all you could need right now to ensure snappy connection speeds. In the box, you get a rather large Wi-Fi antenna, which if we are going to be picky, is more on the ugly side, but it works very efficiently. Another element we feel is a letdown for the board is debugging. It does come with what MSI calls the EZ Debug LED. However, it doesn't feature any of the numbering we've found on cheaper motherboards. It's not the end of the world—at least it has a debugging element, but it makes it slightly harder to troubleshoot if you run into problems.

So, to wrap things up, this board is one of the best chipsets around, has great support for DDR5 (considering there are only two DIMM slots), features lightning Gen5 PCIe, a positive amount of ports, great connectivity, and looks fantastic. For a mini-ITX board, you can't go wrong here. Its only slight issues are an ugly Wi-Fi antenna, its fairly expensive price, and that it could include a more advanced debugging tool. It impressed us though, and if you're thinking of building a small form factor machine, this is a brilliant choice for your PC. **–SAM LEWIS**

VERDICT

9

MSI Z790I Edge Wi-Fi mini-ITX

+ SHARP EDGE High-end mini-ITX board; Good port selection; Great design and heatsinks; Speedy connectivity options.

– BLUNT EDGE More on the pricey side; Bulky Wi-Fi antenna; No LED number debug display.

$349.99, www.msi.com

BENCHMARKS

	ZERO-POINT	
Cinebench R23 Single-Core (Index)	1,962	1,879 (-4%)
Cinebench R23 Multi-Core (Index)	18,502	17,080 (-8%)
CrystalDisk QD32 Sequential Read (MB/s)	7,427	6,808 (-8%)
CrystalDisk QD32 Sequential Write (MB/s)	6,649	5,920 (-11%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point consists of the RTX 4080 machine from the February 2023 issue on page 16. It consists of an AMD Ryzen 7 7700X, Corsair Vengeance 32GB DDR5-4800 RAM, and SK Hynix Platinum P41 PCIe 4.0 1TB SSD. Our Z790I system consists of our Tiny and Mighty machine from this issue on page 16. It consists of an Intel Core i5-13600K, Corsair Vengeance 32GB DDR5-4800 RAM, and SK Hynix Platinum P41 PCIe 4.0 1TB SSD. No manual CPU overclocking was used.

SPECIFICATIONS

Size	mini-ITX
CPU	Intel 12th & 13th generation processors
Socket	LGA1700
RAM	2x DDR5 (up to DDR5 8000+OC), 96GB limit.
Chipset	Intel Z790
Expansion	1x PCIe x16 slot, PCIe 1 Gen PCIe 5.0 supports up to x16 (From CPU)
Storage	3x M.2, M.2_1 Source (From CPU) supports up to PCIe 4.0 x4, supports 2280 devices, M.2_2 Source (From Chipset) supports up to PCIe 3.0 x4 / SATA mode, supports 2280 devices, M.2_3 Source (From Chipset) supports up to PCIe 4.0 x4, supports 2280 devices, 4x SATA 6G
Ports	2x USB 2.0 (Front), 4x USB 3.2 Gen1 Type A (Rear), 2x USB 3.2 Gen1 Type A (Front), 2x USB 3.2 Gen2 Type A (Rear), 1x USB 3.2 Gen2x2 Type C (Rear), 1x USB 3.2 Gen2x2 Type C (Front), 1x HDMI 2.1, 1x DisplayPort 1.4
Connectivity	Intel 2.5Gbps LAN, Intel Wi-Fi 6E, Bluetooth 5.3
Audio	Realtek® ALC4080 Codec, 7.1-Channel USB High Performance Audio, Supports up to 32-Bit/384 kHz playback on front panel
Dimensions	6.69 x 6.69 inches

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ALIENWARE

The addition of a glossy coating really lets the OLED panel sing.

Alienware 34 AW3423DWF

The best just got better—and cheaper

NOT ONLY IS Alienware's alternative OLED monitor, the Alienware 34 AW3423DWF, better than the existing AW3423DW; it's cheaper. How does that work, exactly?

For the most part this is the same monitor, so it's a 34-inch ultrawide model sporting Samsung's QD-OLED technology. It's not just the same technology; it's the same panel, with one alteration, more on which momentarily.

Once again, the resolution is 3,440 by 1,440, the peak brightness remains at 1,000 nits, the claimed pixel response of 0.1ms is carried over, and so on. There are one or two detail changes, and the refresh rate has been dropped from 175Hz to 165Hz. There's likely no technical reason for this ultimately inconsequential change. Instead, Alienware is probably putting a bit of on-paper space between the two screens to justify the price gap.

The same essentially applies to the other major omission: the Nvidia G-Sync Ultimate chip. You don't get it with this cheaper panel, and it really isn't any loss. There's still full adaptive refresh support courtesy of AMD FreeSync Premium Pro, which is compatible with both AMD and Nvidia GPUs. You just don't have to pay for that pricey Nvidia G-Sync chip.

As for the rest of the feature set, you get the same dual-DisplayPort and HDMI video interfaces and slightly old-school USB-A hub. There's no USB-C connectivity, so no single-cable option for laptops. That's not a major issue, given USB-C charging doesn't supply enough power to keep a gaming laptop juiced. The styling is largely the same, albeit the white plastics on the original model have been swapped for black.

So what's that tweak? Nothing terribly high-tech: a glossy anti-glare coating for the OLED panel. The OG AW3423DW variant runs a matte coating, and robs the panel of punch, vibrancy, and contrast. You don't get the full deep-and-inky black experience with a matte coating.

But a glossy coating fixes all that, and really lets the OLED panel sing. Subjectively, the contrast takes a big leap, and the upshot is the kind of experience you're hoping for from OLED. What hasn't changed, and it's a good thing, is that Samsung's QD-OLED tech is currently a better fit for the PC, as opposed to TVs than LG's WOLED alternative. Samsung's panels have better full-screen brightness, and don't suffer as much from brightness limiter algorithms bumping the brightness around as you conduct basic tasks in Windows.

In comparison to LG-powered OLED monitors, including the Corsair Xeneon Flex, this Alienware serves up a relatively compromise-free experience. You can enjoy the upsides of OLED technology, including better HDR performance than any LCD monitor, and the best pixel response, but without the flaws of LG-equipped monitors.

This revised and cheaper Alienware monitor is an easy win over the original G-Sync model. Even for the same money, we'd take it for its glossy panel coating. In a more general sense, it's one of, if not the best, gaming monitors around.

Shop around, and you can get something good for as little as $350, such as the ASRock Phantom PG34WQ15R2B. Is this Alienware really three times the experience? No. It's probably not even twice the experience. Similarly, at this price, all manner of 4K and mega-sized monitors are available. But as a gaming experience, this is as good as it gets, and the best is never cheap. **–JEREMY LAIRD**

VERDICT

9

Alienware 34 AW3423DWF

+ SIMPLY THE BEST Glossy coating make all the difference; Samsung OLED tech rocks.

− ALL THE REST? Still not exactly cheap; Relatively low resolution

$999, www.dell.com

SPECIFICATIONS

Screen size	34-inch
Panel type	QD-OLED
Resolution	3,440 x 1,440
Brightness	1,000 nits
Contrast	1M:1
Response time	0.1ms
Refresh rate	165Hz
Colour coverage	99.3% DCI-P3
HDR support	DisplayHDR 400 True Black
Adaptive sync	FreeSync Premium Pro, G-Sync Compatible
Connectivity	DisplayPort 1.4 x2, HDMI 2.1, USB-A hub

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Netgear Nighthawk A8000

Plug in and get ready for Wi-Fi 6E

IF YOU'RE LUCKY enough to have a Wi-Fi 6E router or mesh system, but you're using an older desktop or laptop that doesn't support the latest networking tech, then you might not be getting the most out of your network. The Netgear Nighthawk A8000 USB dongle aims to address this—it's a simple, affordable way to complete the Wi-Fi 6E loop.

You get two main components in the box with the Netgear Nighthawk A8000. First is the Wi-Fi 6E antenna, which looks like a chunky USB drive and folds out to form an antenna. Second is a dock for this antenna, which connects to your laptop or desktop computer via a USB-A cable. You can either plug the antenna straight into your computer, or use the cradle if it's more convenient for your particular setup or will get a stronger signal.

There's no USB-A-to-USB-C adapter here, so if your laptop or desktop only has USB-C ports, you'll need to supply an adapter of your own. The supplied software that you need to install comes on a USB-A drive as well, so the same applies, though you can also download it from the Netgear website if you need. It's also worth noting that it's a Windows-only device, and you'll need Windows 11 if you want to take advantage of the fastest 6GHz band. This might prove restrictive for some people, again if they're not using the latest computers.

IN THE DESIGN

As for the design, there's not too much to report: it's black, functional, and reasonably compact. It's big as far as USB drives go, so it's good to have the option of the cradle if it's difficult to plug the antenna directly into your laptop or desktop. It's light and highly portable, but does protrude from a laptop to such a degree that you'll have to be careful not to break it.

For testing, we took advantage of Netgear's Orbi RBKE963, the Quad-Band mesh system that sits at the top of the company's consumer range and offers beamforming specifically for the A8000. The dongle supports tri-band connectivity—2.4GHz, 5GHz, and 6GHz. The dongle supports USB 3.0 for the fastest possible connection to your computer, and speeds of up to 1,200Mbps are possible on the 6GHz band.

Your mileage will vary depending on your home and environmental factors such as the thickness of your walls. When testing it with our own Wi-Fi 6E system, we found the connection to be quick and stable, with slight gains in terms of speed compared with a Wi-Fi 6 router and no adapter. While we don't have a huge house, the connection remained strong even at the edges of it, up in the top bedroom, and even out in the back garden. Even with modest performance boosts, remember these will add up day on day, week on week.

We also found that the A8000 is still a worthy upgrade for users of devices that have Wi-Fi 6 or 6E receivers on board, but who want even better speed and reliability, thanks to the device's large antenna. You can, of course, use the A8000 with Wi-Fi 6 routers and USB 2.0 ports, but the speeds won't be as good. The Netgear A8000 is really the only product of its type on the market at the moment, aside from PCI-E Wi-Fi 6E cards, which need more work to install.

The USB dock is also a good addition to the package, as it gives you lots of flexibility when it comes to positioning the antenna and trying to get the best signal. If a Windows laptop or desktop computer on your home network is in need of a Wi-Fi 6E upgrade, then the Netgear Nighthawk A8000 is a great way of adding one with the minimum of fuss and expense, but it's not going to be worth the cost for everyone. **–DAVID NIELD**

VERDICT

8

Netgear Nighthawk A8000

+ **NETGEAR** Excellent performance; Easy to set up; Flexible design.

− **NOTGEAR** USB-A only; Bulky; Wi-Fi 7 on the way.

$90, www.netgear.com

SPECIFICATIONS

WiFi	WiFi 6/6E
Bands	2.4GHz AX (up to 600Mbps), 5GHz AX (up to 1,200Mbps), 6GHz AX (up to 1,200Mbps)
WiFi Speed	AXE3000
USB	USB 3.0
Security	WPA3
Dimensions	3.66 x 1.24 x 0.57 in
Weight	0.99 oz

Razer Audio Mixer

It isn't for everyone, but the Razer Audio Mixer takes the hassle out of stream audio mixing

IF YOU'VE EVER tried to mix audio digitally, you'll know that it can be an absolute nightmare. It's achievable to set up a working streaming setup with nothing more than a mic, some software, and a dream, but be prepared to have to sacrifice easy-to-use sound settings on your PC to get it done. The other option is an external mixing device, like this Razer Audio Mixer.

There are many mixers on the market, and the Razer Audio Mixer is a lot like one of the most popular today, the GoXLR Mini. I've used both, and they share a relatively similar shape, button layout, and connectivity. They're a match in most ways, bar software support. The Razer Audio Mixer is controllable via Razer's Synapse app, which offers output mixing, routing, and mixing for a range of inputs.

From the app, you can choose which audio sources to map to the four fader slide controls on the Audio Mixer itself. By default, you've got Mic, Game, Chat, and Music. If you set Windows up to use each of these channels properly, you can use them to balance your whole PC's audio with these hardware controls alone. That's pretty neat if you're tired of fiddling with Discord and in-game volume controls for every game or friend you're playing with regularly.

That's a handy feature to have, but the appeal here is having independent mixes while on stream. That means one mix for your own headphones versus another for your stream or recording software. The Razer software divides these up as Playback Mix and Stream Mix to make things easy, and they work a treat. If you don't want a particular audio source beaming out to your followers or your own microphone mix through your headset, just flip the switch to turn them off for each mix.

You can plug in both a single XLR microphone and a 3.5mm line into the Audio Mixer, though you can only select one at a time in the app. From here, you can enable 48V phantom power for mics that require the extra juice, or enable and disable a mic monitor. There are also nifty noise gate, equalizer, and compressor features, which saves the extra setup in apps like OBS Studio.

RAZER LIGHT

Being a Razer product, there's heaps of RGB lighting to control. The logo, faders, channels, and buttons all light up all manner of color, and can be tweaked to act differently when muted, or respond to volume—whatever you fancy.

I use a pair of audiophile headphones, and the Razer Audio Mixer doesn't support the 1⁄4 inch audio jack to drive them. Also, you need to hook your headphones up to the mixer, so if you're rocking a pair of wireless cans, pack them away for a pair with a cable.

The Razer Audio Mixer also doesn't drive the loudest output audio I've experienced, and there's no specificity as to the specs of the chipset driving the mixer, which feels like this is simply the maximum oomph this amp can deliver.

This brings me to the elephant in the room: the Razer Audio Mixer's price tag. Razer asks for $250 for the Razer Audio Mixer, but it goes for more like $216 now. That's roughly the same as the price for a GoXLR Mini. It's also a significant chunk more than the Focusrite Scarlett 2i2 3rd Gen audio interface. Although these are slightly different beasts due to the Focusrite's more manual approach to external mixing and its musical background, you can get a similar job done with an XLR mic if you're willing to learn to navigate an external interface.

If you want to take the pain out of digitally mixing your stream's audio, this is a easy and accessible way to do it. But it's a lot to pay for an accessory whose functions can be imitated by software or cheaper hardware if you're prepared to learn. **–JACOB RIDLEY**

VERDICT

8

Razer Audio Mixer

+ IN THE MIX Makes audio mixing easy; All your audio settings under one roof; Solid XLR mic controls; Lots of connectivity options; Simple setup.

− MIXED UP Isn't the loudest; Expensive.

$250, www.razer.com

SPECIFICATIONS

Dimensions	155mm x 115mm x 55.3mm
Controls	4 x Channel Volume Slide Faders, 4 x Channel Mute Buttons, 1 x Microphone Mute Button, 1 x Bleep Button, 1 x 48V Phantom Power Button
Connections	Hybrid XLR and 6.35mm port, 3.5mm Line In port, 3.5mm Line Out port, 3.5mm Headphone Out port. 3.5mm Microphone In port, 1 x USB-C, 1 x Optical Audio Cable
Frequency Response	10Hz–20kHz
Weight	468g without cable

HyperX Cloud III

A comfy headset, but doesn't stand out in the sub-$100 gaming category

HYPERX HAS FINALLY replaced its popular Cloud II gaming headset with... drumroll, please... the Cloud III. It's the company's new mid-range wired gaming headset for $99, putting itself in the middle of a very crowded field of gaming headsets that all cost less than $100. That's a field that includes HyperX's own headsets as well.

The HyperX Cloud III retains the overall design of its predecessor, the Cloud II, with notable upgrades to enhance comfort. The plushier headband and slightly angled ear cups give the Cloud III a nicer fit, making it perfect for wearing during long, marathon gaming sessions.

Personally, I find the plush leatherette-covered memory foam earpads to be a delight, especially when wearing glasses. I've worn them throughout my entire work shift for a few days now, and surprisingly I haven't encountered any major issues. Usually, I find something to complain about when wearing headsets with bulky glasses all day long. These earpads strike the right balance, providing enough softness without exerting excessive pressure on the head while ensuring a tight fit that doesn't compromise sound quality.

Speaking of sound, the Cloud III is still sticking with the 53mm dynamic drivers HyperX has always gone with on the standard (non-Alpha) Clouds. They provide a slightly wider frequency response than your typical 40mm driver headset at this price. I've been playing hours of *Diablo IV,* and am really vibing how ominous the background orchestral tracks play over the sounds of demon corpses exploding.

I was surprised at how well the bass sounded, even without the help of the Bass Boost preset on a mid-range headset. That is a sticking point for many gaming headsets, especially at this price. Unfortunately, the DTS surround sound feature doesn't leave a lasting impression. It tends to be too subtle, making it difficult to discern whether it's even on. If you're seeking a headset with exceptional directional sound, better options include the SteelSeries Arctis Nova 7, albeit at nearly twice the cost.

All of the Cloud III's settings can be adjusted through the HyperX Ngenuity app, which is relatively user-friendly. However, it was a hit-or-miss experience from a technical point of view, as the app sometimes failed to detect the headset. When it does work, the app offers simple customization options for enabling Spatial Sound and adjusting presets and EQs. Fortunately, the Cloud III sounds great and requires minimal tweaking.

The wired headset provides a decent amount of connectivity options. It has a convenient 3.5mm connection, ensuring compatibility with almost anything. It also includes a USB Type-C cable and a handy Type-C to Type-A adapter. This is great if you use a single headset for PC and console gaming.

I like the recent trend of microphones on gaming headsets that sound good—not tinny pieces of garbage. The Cloud III's detachable 10mm boom mic is clear and crisp, albeit a touch quiet, and has built-in noise canceling.

The HyperX Cloud III is a perfectly fine headset that has the misfortune of being the same price as better headsets. For example, the wired HyperX Cloud Alpha is fantastic, only costs $90, sounds excellent, and looks nearly identical to the Cloud III. Even our favorite headset, the wired Razer BlackShark V2, is better than the Cloud Alpha, and costs just $99. While it's maybe not fair to compare this to an older premium gaming headset, you can't ignore the fact that you have to when they're all at this price.

That said, the HyperX Cloud III is a modest upgrade from its popular predecessor that is incredibly comfortable to wear. If you need comfort over anything else, the Cloud III is a great pick. However, if you're looking for stellar sound and plenty of features at $99, you've got a load of better options. **–JORGE JIMENEZ**

VERDICT

7

HyperX Cloud III

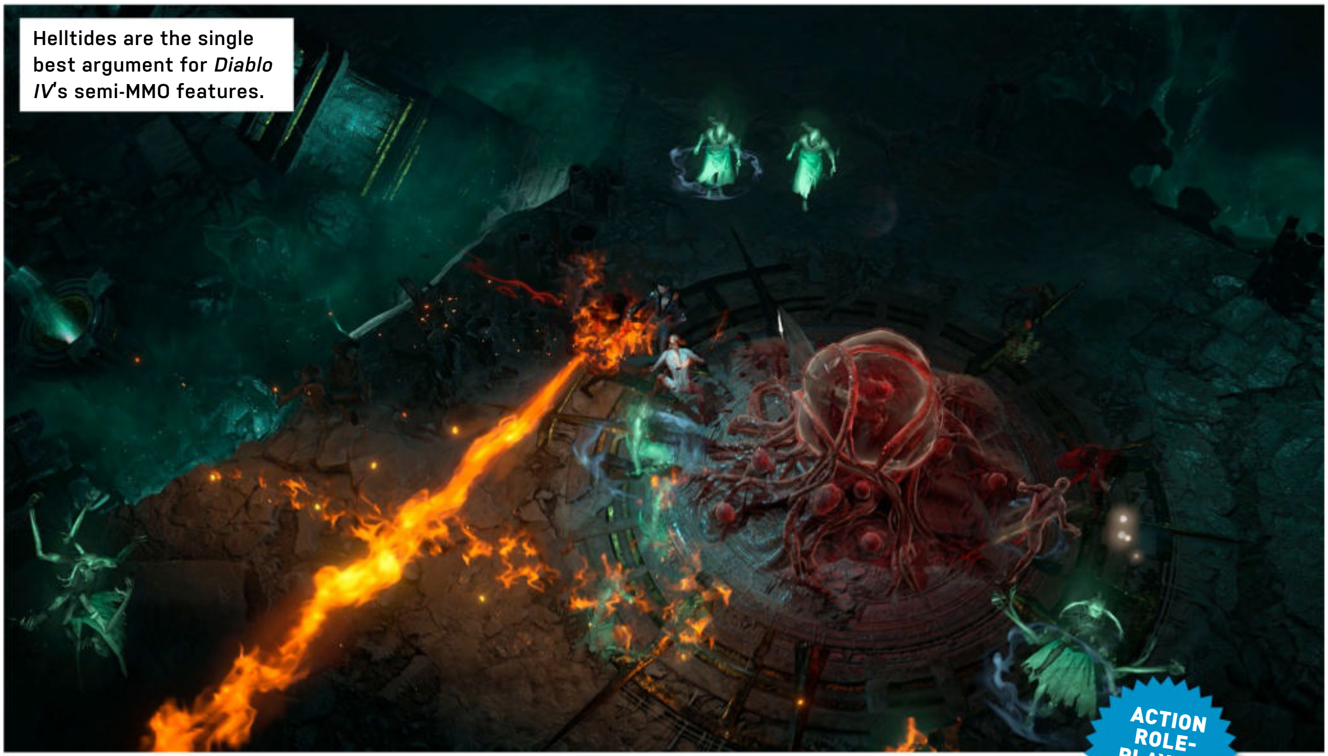
+ **THIRD TIMES A CHARM** Really comfortable; Plenty of wired connectivity options; Great bass.

− **THREE'S A CROWD** Virtual Surround is subpar; Way better options at $99.

$99, www.hyperx.com

SPECIFICATIONS

Operating principle	Closed back
Drivers	Angled 53mm drivers
Frequency response	10 Hz - 21,000 Hz
Connection	3.5mm, USB Type-A, USB Type-C (dongle)
Microphone	Detachable 10mm
Pickup	Unidirectional
Weight	320g (with mic), 308g (no mic)



Helltides are the single best argument for *Diablo IV*'s semi-MMO features.

ACTION ROLE-PLAYING GAME

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Diablo IV

Almost buries everything that makes it great

DIABLO IV TRIES to ground us in its dark fantasy world, but that's an impossible task in a game where you can pull a legendary two-handed axe out of a wolf. The storytelling is as subtle as a Marvel movie, and about five times as long, and no matter what *Diablo IV*'s cast of dour characters tell you, you are a superhero born with an empty inventory and the desire to fill it.

The title of Blizzard's latest action RPG hides what's really going on: *Diablo IV* is a reboot. An unnecessary reboot, but one with a recognizable goal: to reconfigure the series' strengths into a modern live service format that fits into the lives of players who probably have a handful of other games to play. Once you finish its campaign, its glorious depth reveals itself, but the overwhelming grind restrains the creativity in its intricate RPG systems.

Today's prevailing live service structure, exemplified by *Destiny 2*, might seem to be a good fit for *Diablo*'s historically replayable co-op design, but it actually requires a huge structural shift. *Diablo IV* begins like a story-driven adventure, but it's not until you finish the campaign that its best parts start to unfold. Entire features, like the MMO-inspired Grim Favors quests or the almost roguelike Helltide events, are held back until you've suffered through a 10-hour storyline that tries to reset the over-the-top tone from *Diablo III*, but goes overboard with the grimdarkness without fundamentally changing what a Diablo game is about (killing demons).

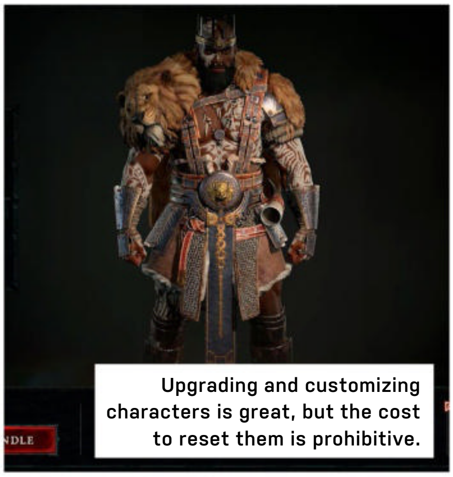
Blizzard's reaction to complaints that Diablo III wasn't "dark" enough led to something so bleak, it's suffocating. While the campaign focuses on the growing threat of Lilith, the "Mother of Sanctuary", the side quests offer different flavors of misery. Almost every character you meet does something awful, like betraying their own children, making a pact with demons, or murdering someone over a petty dispute. I've helped so many people find their dead family members or have had to kill them that I stopped listening to NPC requests. I was desperate to find joy or hope in all the people I'm supposedly fighting for, and routinely found none.

The thematic "return to darkness", or return to *Diablo II*, that *Diablo IV* promises only works when that horror meaningfully affects how you play. One early dungeon set in a monastery had me chasing after a lead on Lilith. I expected demons and dead monks, but what I found were eerily empty hallways. In the distance, I heard doors slam shut and screaming. Instead of another dungeon where you fight through nameless enemies to find your target at the end, I was stalking a murderer just out of my reach. The urgency with nothing but the sound of my footsteps echoing through the halls made for one of *Diablo IV*'s most chilling sequences.

That sort of upending of expectations is rare to find in *Diablo IV*'s quests, though. Much of it is held back for the endgame in features like Helltide events, which blanket a portion of the map in blood (literally) and supercharges all the demons there. You get one hour to kill as many as you can to collect their Aberrant Cinder drops and open as many rare item chests as you can. Dipping into these events solo puts you at risk of dying and losing half of your Cinders, but grouping up can drastically reduce the challenge.

With its ridiculously slow pace and inability to establish a villain with comprehensible intentions, *Diablo IV*'s campaign doesn't justify how long it takes to get through it. It offers few surprises, and even when it seems like it might, it quickly veers back into the same story you've seen in these games. *Diablo IV*'s campaign can't solve the Eternal Conflict between angels and demons, and its

You'll need more than 100 hours to even scratch the surface of what *Diablo IV* has to offer.



Upgrading and customizing characters is great, but the cost to reset them is prohibitive.

Diablo IV is a triumph that will decimate your free time.

We don't know whether it will survive as live service, but single player alone is excellent.

ending is so inconsequential that I'll gladly use the option to skip it on every new character I make.

MISERY BUSINESS

After finally finishing *Diablo IV*'s campaign, I was let loose in its open world with all sorts of loot-hunting activities to do. Dungeons get harder and the game starts to require that you squeeze as much damage as you can out of your class—a targeted attack on my character-build-obsessed brain. Years of playing Blizzard games does that to you; it started with *World Of Warcraft*, and it continues every day with *Overwatch 2*. The developer has a talent for reaching into the guts of a genre and pulling out its heart.

The fundamental experience of playing *Diablo IV*, of clicking on demons and watching items pop out of them, activates my neurons in a way that's almost embarrassing to admit. Up until now, I hadn't realized that a core mechanic in action RPGs like this is to guarantee that the last enemy you kill in a group drops the loot to punctuate your 30 seconds of fun. It's a slightly unsettling yet clever piece of design that keeps you hungry in a game full of food. I really am a rat in a box, but that doesn't stop me from enjoying it solo and in co-op, although your first co-op playthrough might feel too easy until the later World Tier difficulty options.

The deeper you get into *Diablo IV*, the harder it gets to change your playstyle. It's one of the consequences of trashing *Diablo III*'s brilliant rune system, which allows you to swap your skills for free at any time in favor of a *Diablo II*-style skill tree. This is only made worse by how important your gear is to your build. Legendary items come with aspects that alter how your skills work, and many of these can define your build. If I were to drop the aspect that generated my Necromancer's resource when I slow enemies, I wouldn't be able to cast enough Bone Spears to survive late-game dungeons. The power of aspects and the cost of imprinting them onto rare items restricts how many times you can experiment with them unless you spend loads of time farming for gold and materials. Right now, it would cost me 100,000 gold to reset my skills, and then I would have to spend more gold and rare materials from salvaging Legendary items to replace the aspects on my gear.

Diablo IV's live service structure conflicts with the joy of building your character into a god—like you do by the end of the previous games—but it does leave it an opportunity for Blizzard to identify and embrace the game's best parts through seasons or future patches. Right now, most of those things sit at the latter half of the game, and are restrained by resource scarcity and tight enemy level scaling. It's so close to channeling the progression-hungry energy that I need in a game about turning the legions of Hell into my precious loot crops. I need Diablo IV to treat me like an adult who will rerun a dungeon 10 times for gear from the very start. I need it to encourage the kind of creativity its classes deserve, because every second it doesn't, all its potential is wasted.–**TYLER COLP**

VERDICT
8

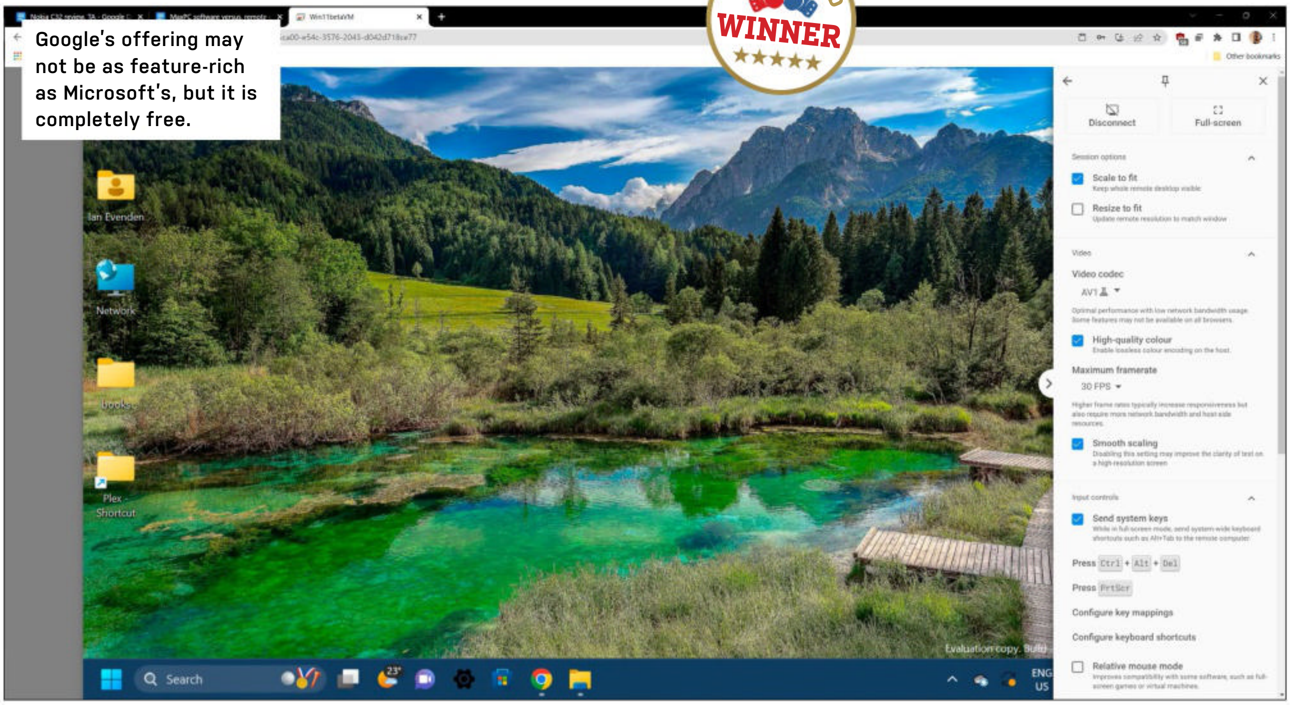
Diablo IV

DEVIL'S ADVOCATE Incredibly fun core experience; Addictive skill trees; Enjoyable Helltide events.

DEVIL MAY CRY Ridiculously slow-paced campaign; Expensive to re-spec characters; Live service structure.

RECOMMENDED SPECS CPU, Core i5-4670K/AMD R3-1300X. GPU, GTX 970/Radeon RX 470. RAM, 16GB

$69.99, diablo4.blizzard.com, M-rated



Session options

☑ Scale to fit
Keep whole remote desktop visible

☐ Resize to fit
Update remote resolution to match window

Video

Video codec
AV1
Optimal performance with low network bandwidth usage. Some features may not be available on all browsers.

☑ High-quality colour
Enable lossless colour encoding on the host.

Maximum framerate
30 FPS
Higher frame rates typically increase responsiveness but also require more network bandwidth and host-side resources.

☑ Smooth scaling
Disabling this setting may improve the clarity of text on a high-resolution screen

Input controls

☑ Send system keys
While in full-screen mode, send system-wide keyboard shortcuts such as Alt+Tab to the remote computer

Press `Ctrl` + `Alt` + `Del`

Press `PrtScr`

Configure key mappings

Configure keyboard shortcuts

☐ Relative mouse mode
Improves compatibility with some software, such as full-screen games or virtual machines.

Google's offering may not be as feature-rich as Microsoft's, but it is completely free.

HEAD TO HEAD WINNER ★★★★★

Chrome Remote Desktop vs. Microsoft Remote Desktop

What's best for accessing your computer from afar?

WE SPEND MUCH of our time with firewalls and other security apps trying to prevent other people from connecting to our PCs and taking control of them over the internet. However, there are times when you need to help someone out, or administer one of your computers while you're not physically sitting in front of it. This is where Remote Desktop applications come in.

Administrators of large numbers of commercial PCs will have networks set up specifically with this in mind, using commercial software packages such as TeamViewer, but there are also free options that are ideal for anyone who just wants to remote-control one Windows PC at a time.

Two of the most easily acquired are Microsoft Remote Desktop, or RDP, which comes bundled with some versions of Windows, and Chrome Remote Desktop (we'll call it CRD), which can easily be installed as an extension to the Chrome browser. You'll need to have that particular web access software installed to use it, which means Edge will probably whine at you, but can be safely ignored in this instance.

Both allow you to remotely control a Windows computer via another PC, a Mac, or even a mobile device. You can use them to take control of a virtual machine that's running on a server PC with a much less powerful computer, providing a sort of thin client functionality across a network, or just dip in and out to provide tech support to a less computer literate relative over the internet—as long as you set it up properly to begin with.

You'll need a Pro or Enterprise version of Windows 10 or 11 if you want RDP users to connect to your PC. It's included in the OS, so you'll find an option in Settings > System > Remote Desktop to switch it on. Any computer with the correct app and login details can now connect to your PC and take control, but you can only set a Pro version of Windows up to be the controlled one.

You'll also need an app on the client device—the one you'll use to connect and take control with. This can be found in the various app stores, usually called RD Client—it's available for both kinds of mobile device, and Mac computers, too. For Linux, there are open-source RDP clients available, such as Remmina, and a web app that'll work on a Chromebook.

Microsoft's RDP might not be the best choice if you're trying to help out a relative, as aside from the need for a Pro version of the OS, you'll need to do a bit of setup before it can be used. You'll also need to know the public IP address of the target PC if connecting across the internet, and as the default port RDP uses is well known, you'll also need to know how to set a strong password, just in case somebody else decides to slip inside with less helpful intentions.

You might also need to forward this port on your router—something that's not difficult, but varies by brand and even model number. Once you've got it working, however, there's a lot to be said for using Microsoft's built-in method. If you're using a Windows PC to administer a Windows client, you get great performance and integration with Teams. There's no direct chat client built into the app, however.

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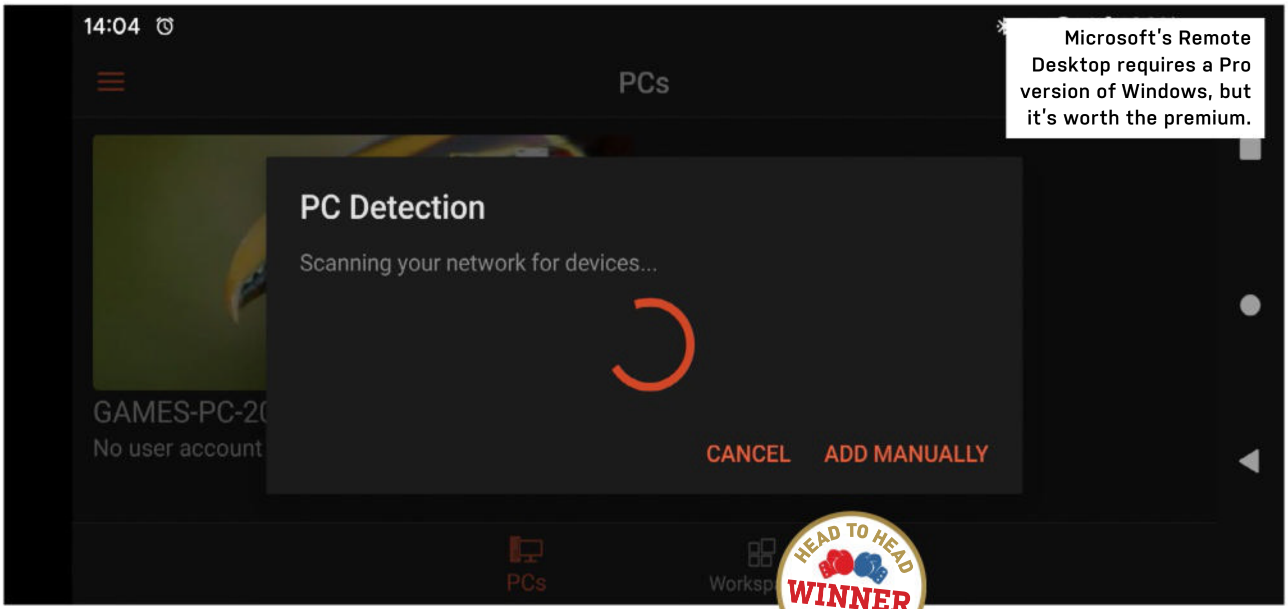

PC Detection

Scanning your network for devices...

Microsoft's Remote Desktop requires a Pro version of Windows, but it's worth the premium.

File transfer is possible too, with both computers' drives, including network shares (and multiple displays) accessible if you allow it. Using a non-Windows client can cut down the options somewhat, but there's enough to take control of the PC and fix issues, even from an Android phone, though you'll have to do a lot of scrolling around on the smaller screen.

Both Microsoft Remote Desktop and Chrome allow you to decide whether the host machine's output resolution is changed to match the client device, or whether it's scaled, and whether touchscreen inputs act as if the touchscreen is a trackpad or not.

SUBHEAD

Google's version of the Remote Desktop runs through its Chrome web browser, so it can be installed on any version of Windows that supports that app—Pro or Home edition, it doesn't matter.

As it's totally free, you might expect there to be some fatal flaw that makes the software unusable except for emergencies, but while it might be light on features, Chrome Remote Desktop is completely functional as a remote access app.

Once you've got CRD installed on your PC, you'll need to be signed into a Google account to use Chrome Remote Desktop. It's installed as a Chrome extension from the Chrome Web Store, and also exists as an Android or iOS app, so you can control the target computer from a mobile device.

The Chrome solution is easier to install and set up than Microsoft's, as it works through your Google account. PCs acting as a server will identify themselves to clients and be added to the client app, from where they can be clicked on. You can set up a PIN for extra security, too.

If you're using CRD to get help with your PC, you can generate a single-use code and send it to the person helping you. They can use that to log into your PC and take control. As an extra form of security, you'll need to confirm you want to share your screen every 30 minutes.

CRD has a responsive interface, and there are several options via a pull-out window at the side—at least on a desktop computer. Mobile devices don't have many of these. They include the video codec used—you can swap between VP8 and VP9 to see if either gives you better performance, or an experimental AV1 option, with the last two offering lossless encoding for better color reproduction.

One of the best things about CRD is that it just works—it doesn't need the same network configuration or sniffing out of IP addresses as Microsoft's solution. However, it loses out to MS in terms of features—you can sync your clipboard across the two connected PCs, but there's no file transfer.

It's tricky to decide which one is best. They both work well over local networks and the internet, though the ease of setup from Chrome works in its favor. Which one you choose will depend on whether you want file transfer, and whether your host PCs run the right OS. If the answer to both these questions (or even just the second one, which is core to getting RDP to work) is 'no', then CRD offers a stable connection and responsive remote control with good security.

The Microsoft solution is probably best for a professional environment, as it offers Teams and Azure Desktop integration that home users just won't need, while Google's Chrome Remote Desktop is better suited to home users who just want to log into their grandmother's laptop and work out why she can't stream her stories. Being able to remote control a PC from your phone (or anywhere else) is a powerful thing, and having two such high-quality apps that can do it for you means. **–IAN EVENDEN**

VERDICT 9

Chrome Remote Desktop

➕ **CONNECTION** Easy to use; Completely free.

➖ **CONNIPTION** Not as many options as MS; No file sharing.

Free

VERDICT 9

Microsoft Remote Desktop

➕ **REMOTE** Built into Windows; No fees.

➖ **CONTROL** Needs a Pro OS; Can be complex to set up.

Free (with Pro version of Windows)

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LETTERS

WE TACKLE TOUGH READER QUESTIONS ON…

- > Podcast Petitioning
- > Creative Demands
- > Nvidia Driver Confusion
- > Honest PC Magazine

No More BS

I read the letter in the July issue suggesting the resurrection of the No BS Podcast. I would love to see the podcast return. During its run, it made many of my long drives much more enjoyable!

Also, I'd love to see a head-to-head of several WiFi 6E routers and your declaration of the best WiFi 6E router. Love the mag.

–J. Hirsch

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: Thanks for your encouragement on bringing back the podcast. Over the last few issues, I've really enjoyed jumping on a mic with Sam every four weeks and hearing about that month's build. There are always interesting stories to each cover feature, like power supplies that don't work, systems that don't boot, and things we'd do differently next time, which we often don't have time to go into in the feature itself.

I've also gone back and looked over old No BS Podcast episodes from the archive (which are available on YouTube), and I'd personally love to bring it back—I have experience in podcasting and radio, and love all that stuff. I think we'd need to bring in one of our other contributors, though, like Jarred Walton, Jeremy Laird, or Nick Peers, to make an engaging discussion, otherwise it's just me and Sam again! But yes, it's something that I'll continue to think about as long as we have the resources to do it well, as I think it will help offer more to readers in our new digital form.

In terms of WiFi 6E routers, your question arrives with perfect timing, as I've been using Netgear's Orbi RBKE963 mesh system in order to test the company's Nighthawk A8000 dongle this month (see page 87). I personally don't need the dongle, as both my laptop and desktop come with WiFi 6E baked in, although I will say that the Netgear dongle still improved my signal and data transfer rates in testing. However, I tend to spend most of my working day at my desktop, plugged into my home network over an ethernet connection, which will always be my preferred method of connectivity where possible.

That said, the Orbi RBKE963 is a fantastic WiFi 6E system, but then again, it should be for a $1,500 3-node system. Where I live, I currently have a 150Mbps cable broadband connection, which I pay less than $20/month for. Yes, there's a 3Gbps package available for $65 a month—not crazy, but not essential in these times of high cost of living. Yes, I sometimes wish my Steam downloads were a little faster, but I can make do, and I also live in a small apartment that only needs a couple of WiFi access points to work effectively. That's why I've stuck with my Linksys Velop WiFi 5-based system for so long. I love adopting the latest technology, but in the case of WiFi 6, 6E, and even 7, which is now starting to trickle through, there's currently quite a premium on those systems.

Again, though, your case may be different, which is why I'll look at doing a roundup of WiFi 6E routers and mesh kits in an upcoming issue.

Melting Point

I think you have an error on page 70 of the July issue. If you have a soldering iron at 2,200°C (which is actually 3,992°F), it would melt everything—including the gold contacts, steel, and everything except tungsten! I think possibly you added an extra zero and did the Celsius to Fahrenheit conversion wrong!

Finally, how about building a rig for creative types like me who use Adobe Lightroom and Photoshop for storing, editing, and publishing photos (and occasional videos)? My setup needs to support two 4K screens (I don't need very high frame rates, but I do need to be able to draw things quickly). I also need plenty of CPU horsepower to apply

↘ submit your questions to: editor@maximumpc.com changes, lots of memory, very fast internal storage (think multiple, large M.2 SSDs), plus very large, fairly fast external storage (at least RAID1). I currently use an Intel Core i9-11900KF, 64GB RAM, Nvidia RTX 3080, 2TB WD Black, and 36TB LaCie external drive set up in 18TB RAID1. **–J. Taylor**

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: Many thanks to yourself and fellow reader M. Ososki for pointing out our error on the temperatures! Apologies, it slipped through our checks, and let me say that here on *Maximum PC*, we don't recommend doing *anything* at 2,000+°C! Apologies again for the error.

We're getting regular requests to do a creative-focused build in an upcoming issue, which I'm sure will be music to the ears of our resident PC builder, Sam Lewis, who himself comes from a graphic design background. Mr Taylor's specs sound pretty high, particularly in terms of storage, but I know video editors and photographers who would have similar demands, as more power, memory, and storage allows them to work faster, ultimately saving them time and money. It also doesn't hurt to have a RAID 1 system as Mr Taylor suggests so that you always have a backup if things go wrong. As a consumer, I tend to use RAID 5 (or Synology's equivalent, Synology Hybrid RAID), as you'd be unlucky to have two disks fail on you simultaneously, although obviously with an offsite overnight backup happening to truly protect yourself. I have an iDrive 10TB annual subscription because they offer one of the best value packages I could find, but other options are available.

I do a little bit of video editing myself, but on the consumer side, I recently made the decision to give up my own personal Synology NAS, and just move everything to the cloud. This was partly due to increased energy costs making running my server 24/7 more expensive, but also it was to try and cut down on the amount of data I was hoarding on my own local storage. I feel much better about having it centralized on a couple of online services, but this wouldn't work in Mr Taylor's case, as he needs fast localized storage.

So thanks for the letter—plenty of ideas there for future builds, as well as features on storage options for creatives.

Studio Ready

In the latest issue (July 2023, page 31), you discuss using Nvidia's Studio drivers if you're using one of the company's GPUs primarily for creative work, rather than gaming. When looking at the Nvidia website, that seems to be a laptop product. Is that your take? **–R. Matlow**

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: No, not at all—Nvidia's Studio drivers are meant for both desktop and laptop processors. Using the Studio option rather than the Game Ready one just means that the drivers, which are what your operating system uses to interface with the graphics card, are more attuned to creative tasks than playing games. Honestly, we need to do a side-by-side comparison in a future issue to see what the difference actually is between the two if you're using Adobe Premiere, for example, and how much using Studio drivers will impact on your game of *Diablo IV*. But the idea is you'll get the best performance from each one by using the right drivers, as well as needing to do fewer updates on the Studio side, which is important for creatives who just want to be getting on with their workflow.

I went to see Nvidia at the Consumer Electronics Show earlier this year, and they had three booths—for laptops, game streaming, and creatives. In the latter, they showed off NVIDIA Broadcast with Eye Contact, Video Super Resolution, and lots of other ways they were supporting creatives in the visual effects and video game creation industries. In tandem with AI, it's clear that this market is going to become more vital to them, in addition to the gaming stuff we tend to focus on.

Honesty

My wife has gifted me a *Maximum PC* subscription for years now, and it's the best magazine, full stop. I must ask you to praise Jeremy Laird for his fantastic article, 'The Great Graphics Card Bubble' (June 2023, page 42). Jeremy doesn't pull any punches, and it's easy to tell that no one at *Maximum PC* kowtows to the big companies. Certain "respected" online websites or YouTubers do not remain as neutral, so kudos to you and Jeremy.

You guys strike a good balance of rooting for Nvidia, AMD, and Intel, while still telling it like it is when these greedy parasites overcharge their customers. There was a time when consumers would not put up with that kind of price gouging, but in the last few decades, corporations have become so powerful that consumers no longer have any significant power. **–S. Philips**

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: Thank you for complimenting our writers, as well as appreciating the standards we try to uphold on *Maximum PC*. I think it's an important point that we don't always discuss in these pages—yes, we hold close relationships with a lot of the manufacturers we cover, as it's how we source the products we feature and review, as well as get access to announcements before they're made public. However, we maintain our editorial independence and always print what we think, no matter what impact that might have on those relationships. I've been in journalism for nearly 20 years, and I've found that the key is to contact the PR people at these companies when you're being critical, and give them the chance to reply. Most of the time, they're just as aware of the flaws of their company or products as we are—after all, they've probably known about them for longer.

There are some excellent online outlets and YouTubers, but few I truly trust. Part of that is the ambiguous nature of what's editorial and what's paid-for content, but it's also the level of rigor they're applying. Just this month, a couple of vloggers apologized for their RTX 4060Ti reviews (see ours on page 74) because they were condemned by their viewers for going too soft on it. We always stand by what we publish and trust our audience to make their own minds up.

As for consumer power, I don't think we've completely lost that battle; it's just taken a long time and a lot of patience from anyone waiting the last couple of years for a good-value graphics card. Believe me, companies notice if their products aren't selling, so vote with your wallet if you're feeling taken advantage of.

THE BUILDS

THIS MONTH'S STREET PRICES...

BUDGET

IN OUR BUDGET BUILDS last issue, we made a handy $5 upgrade on our RAM to boost this from 3200MHz to 3600MHz—well worth the price of a slice of cake and a coffee. This RAM kit was PNY's XLR8 Gaming EPIC-X RGB 16 GB sticks, a choice of RAM we've used for a while now and are big fans of. It's affordable, snappy, and looks great. This is being used in not only our Intel budget machine, but also our AMD budget build.

Another component that is shared across both teams is the SSD, and we've decided to upgrade that, too. Out goes the PNY CS2140 and in comes the Corsair MP600 PRO NH. For an extra $13, we are improving our read speeds from 3600MB/s up to 7000MB/s. Our write speeds are also increasing from 3200MB/s up to 6500MB/s. As for our backup drive, the Seagate Barracuda Compute, this 2TB 7200 RPM HDD is plenty of storage for these budget machines. At $50, it's well worth adding to the mix.

We saw a few price changes on our Intel build this month. The ASRock B660M Pro RS Micro ATX went back up to $112 from a more charming $95. Our GPU, the Intel Limited Edition Arc A750 8GB, went back up to its $250 RRP, which is still a great price, but the previous $230 price tag was better to look at. These changes sadly bring our Intel price up to $828 from $778.

On the AMD budget machine, we introduced the ASRock RX6500XT CLI 4G card last time, but we are already replacing that. We want a more comparable card to the 8GB A750 on the Intel build, so we've brought in the ASRock Phantom Gaming D OC Radeon RX 6600 XT 8 GB card. We're always trying to keep costs down, but we felt like the previous card was a little underpowered—this 6600 XT will make for a better 1080p gaming experience. This brings the AMD machine up to $825 (just $3 shy of our Intel machine). From last time, that's an increase of $83, but now with a better SSD and GPU added to the picture.

AMD INGREDIENTS

PART		PRICE
Case	Corsair 4000D Airflow	$95
PSU	450W Corsair CV450 80+ Bronze	$59
Mobo	MSI B550M PRO-VDH WIFI Micro ATX AM4 Motherboard	$119
CPU	AMD Ryzen 5 5600	$130
GPU	ASRock Phantom Gaming D OC Radeon RX 6600 XT 8GB **NEW**	$230
RAM	16GB (2 x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3600MHz	$50
SSD	500GB Corsair MP600 PRO NH PCIe 4.0 M.2 SSD **NEW**	$60
HDD	2TB Seagate Barracuda Compute 7200	$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$825**

INTEL INGREDIENTS

PART		PRICE
Case	Corsair 4000D Airflow	$95
PSU	450W Corsair CV450 80+ Bronze	$59
Mobo	ASRock B660M Pro RS Micro ATX GA1700	$112
CPU	Intel Core i3-13100F	$120
GPU	Intel Limited Edition Arc A750 8GB	$250
RAM	16GB (2 x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3600MHz	$50
SSD	500GB Corsair MP600 PRO NH PCIe 4.0 M.2 SSD **NEW**	$60
HDD	2TB Seagate Barracuda Compute 7200	$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$828**

MID-RANGE

THANKS TO a mention in our comments section from a reader, we upgraded our CPU coolers previously in the mid-range builds. We used to feature the Cooler Master MASTERLIQUID ML240L RGB V2 AIOs here, but we found out that although they were compatible, they didn't come with an LGA1700 bracket in the box, so we swapped both of these out and chose the MSI MAG CORELIQUID 240R V2. It was $20 more than the other cooler, but this saves you from having to go and get brackets, as it comes with an LGA1700 and AM5 bracket in the box. We kept these coolers firmly in place to prevent any further compatibility issues.

Another two components that we changed last time and are keeping in place are our CPUs. We upgraded both the AMD and Intel chips, bringing the AMD Ryzen 5 7600X and Intel Core i5-12600K to the forefront. Performance is similar, though Intel's offering does have more cores, but the AMD has the higher boost clock speeds, giving it an edge when it comes to gaming.

On the AMD side, the ASRock B650M PG RIPTIDE Wi-Fi Micro ATX AM5 was replaced by the ASRock B650E PG RIPTIDE WIFI ATX AM5 mobo, giving us a greater range of compatibility. Lastly, for the mid-range AMD machine, we substituted the Crucial P5 Plus for a speedier PNY CS3140. This costs an extra $5, and has quicker read/write speeds than the Crucial P5 Plus, so it wasn't a hard decision. This brought the total up to $1,450 from $1,442.

The Intel mid-range build saw no hardware changes, unlike its AMD counterpart. The only changes we saw were with some of the prices, but these were on our side. A promo on NEWEGG.com meant that our Intel Core i5-12600K fall to $205—even better value for money than it already was! The MSI MAG CORELIQUID 240R V2 was also on sale at $95, so that helped not only this build, but the mid-range AMD machine. Overall, the Intel machine ended up costing $1,365, less than the AMD build.

AMD INGREDIENTS

PART		PRICE
Case	NZXT H7 Flow	$130
PSU	750W EVGA 750 BP 80+ Bronze	$90
Mobo	ASRock B650M PG RIPTIDE Wi-Fi Micro ATX AM5 **NEW**	$240
CPU	AMD Ryzen 5 7600X	$240
Cooler	MSI MAG CORELIQUID 240R V2	$95
GPU	Gigabyte Radeon RX 6750 XT Gaming OC 12GB	$400
RAM	32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	$98
SSD	1TB PNY CS3140 NVME M.2 PCIe 4.0 SSD **NEW**	$75
HDD	2TB Seagate Barracuda Compute 7200	$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32

Approximate Price: $1,450

INTEL INGREDIENTS

PART		PRICE
Case	NZXT H7 Flow	$130
PSU	750W EVGA 750 BP 80+ Bronze	$90
Mobo	Gigabyte Z790 UD AC ATX LGA 1700	$195
CPU	Intel Core i5-12600K	$205
Cooler	MSI MAG CORELIQUID 240R V2	$95
GPU	Gigabyte GeForce RTX 4060 Ti EAGLE 8GB	$400
RAM	32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	$98
SSD	1TB Corsair MP600 PRO NH M.2 PCIe 4.0	$70
HDD	2TB Seagate Barracuda Compute 7200	$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32

Approximate Price: $1,365

TURBO

FINALLY, we can stop worrying about our final price tag, and focus more on outright power with our top-end turbo machines. It's where we can show off some of the best components money can buy on both teams Intel and AMD. This usually comprises CPU/GPU combinations that are fantastic, but equally, may make your stomach churn when you glance at the price.

Talking of, for the Intel build we're not swapping either of these two components out until something can dethrone them. Although the price tags aren't as important on these builds as the others, we still love to see a reduction or two. Just like on our Intel Core i5-12600K, NEWEGG.com has a promotional offer, and that brings the i9 13th gen chip to $560. The problem here is that last month, another sale meant it was $500, so although we have a sale here, it's bittersweet.

As for the GPU, we are making a slight change to another Zotac card. We are bringing the Zotac GAMING AMP Extreme AIRO GeForce RTX 4090 in to replace the Zotac GeForce RTX 4090 GAMING Trinity OC. This new change improves the boost clock speed up to 2580 MHz from 2535 MHz. Also, it's only $2 more than the previous GPU because of another NEWEGG promo—thanks to the folks over there! As we made changes to our cooler and PSU last time, there was nothing else to change here for the Intel turbo machine. It now costs $3,420, up from $3,373.

Swimming over to island AMD, and NEWEGG has saved us a few cents here, too. The AMD Ryzen 9 7950X3D had a $30 sale down to $670. That's still nearly as pricey as our budget builds for just one component, but then again, that's the point with the Turbo machines. Aside from this, the rest of the components remained the same. We kept the ASRock Phantom Gaming OC Radeon RX 7900 XTX. This is one of the lowest price 7900XTX cards you can pick up, but that doesn't mean it's cheap. It's sitting at $980, which is still a hefty amount, but when we compare this to our RTX 4090 on the Intel machine, it's $611 less—yikes! Anyway, the AMD build this time around comes in at $2,954, up by only $3 in the end due to other price fluctuations.

AMD INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Pro 2 Tempered Glass	$190
PSU	1000W NZXT C1000 80+ Gold	$180
Mobo	ASRock X670E PG Lightning ATX AM5	$260
CPU	AMD Ryzen 9 7950X3D	$670
Cooler	NZXT Kraken X73 Elite RGB 360mm	$300
GPU	ASRock Phantom Gaming OC Radeon RX 7900 XTX 24GB	$980
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	$165
SSD	1TB WD Black SN850X M.2 PCIe 4.0	$77
HDD	6TB WD Blue 5400 HDD	$100
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$2,954**

INTEL INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Pro 2 Tempered Glass	$190
PSU	1000W Corsair RM1000x Shift 80+ Gold	$210
Mobo	Gigabyte Z790 UD AC ATX LGA 1700	$195
CPU	Intel Core i9-13900K	$560
Cooler	NZXT Kraken X73 Elite RGB 360mm	$300
GPU	Zotac GeForce RTX 4090 GAMING AMP Extreme AIRO 24GB **NEW**	$1,591
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	$165
SSD	1TB WD Black SN850X M.2 PCIe 4.0	$77
HDD	6TB WD Blue 5400 HDD	$100
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$3,420**

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